EQUITY AND EFFICIENCY CONSIDERATIONS IN ELECTRICITY PRICING: THE CASE OF EGYPT

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THESIS SUBMITTED FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

TO THE UNIVERSITY OF LONDON

JUNE 1991

ABSTRACT

This thesis analyses the issue of electricity pricing in the residential sector of Egypt and shows that the upsurge in consumption that took place since the mid Seventies in this particular sector was mainly due to the tariff policies of the government which did not reflect the true economic costs of supply.

Since residential consumers have not been getting correct signals to guide consumption decisions so far, an alternative tariff structure is necessary to prevent the future loss of economic efficiency and associated social welfare. However, although such a tariff structure will have to satisfy the criterion of economic efficiency, in that it would have to reflect the associated marginal costs, there are other objectives that have to guide electricity tariff policies, especially in developing countries. The most notable is the equity objective which tries to ensure that the poor segments of the population receive electricity at affordable prices, i.e., at life-line rates. Additionally however, in Egypt, as in many other developing countries, tariff structures are usually unable to raise enough revenues from the rich at the upper-end of the tariff to subsidize the consumption of the poor. Furthermore, the rich quite often get the benefit intended for the poor through the life-line rates.

In spite of successive electricity price increases by the Egyptian government in the last few years, the tariff structures have been unable to raise enough revenue to cover deficits and thus have jeopardized the financial viability and autonomy of the electricity sector.

The last part of this thesis examines several alternative tariff structures for the residential sector, based on several different initial conditions, and measures the impact of each on consumption, expenditure, and revenue. The major contribution is thus, a methodology to assess and evaluate the welfare loss entailed by the implementation of any tariff structure which policy-makers could use to guide future tariff policy decisions.

ACKNOWLEDGMENTS

I would like to express my most sincere gratitude and appreciation to my supervisor, Dr A Markandya, for his encouragement, constructive criticism and useful suggestions throughout this research.

Thanks are also extended to Professor D Pearce for his kind guidance and support.

I am also most grateful for the hospitable environment provided by Professor R Blundell.

Last, but by no means least, I am particularly grateful to my parents and to my dear wife, Maha, who acted both as mother and father to my little son, Ahmad, during the protracted writing of this thesis.

IN THE NAME OF ALLAH
THE MERCIFUL AND BENEFICENT

For
my parents,
my wife Maha
and my son Ahmad

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CHAPTER ONE

ENERGY USE AND EFFICIENCY IN EGYPT WITH SPECIFIC REFERENCE TO ELECTRICITY

1. Introduction:

In the 1970's, some dramatic and important changes were witnessed in Egypt which affected all aspects of the economy and conditioned, for a long time to come, the social and political environment within which the economy has to be managed as well as for the development process to be brought about.

Through the introduction of the open-door economic policy of trade liberalization and private sector incentives, Egypt experienced a period of rapid and significant growth which was reflected in the overall growth rate of real GDP. From the onset of the open-door policy, as shown by Tables (1.1) and (1.2), an average growth rate in real GDP of 10.6% per annum was realized throughout the period 1975 to 1981/82. However, such a significant rate of growth stands in marked contrast to the weak performance of the previous decade when only less than 3% per annum was achieved from 1966 to 1971 and 5.5% from 1971 to 1975 [62].

Nonetheless, the growth of the economy has initiated two main variables. First, it meant a rapid and considerable growth in the internal demands of the economy for energy. Secondly, the growth of the economy has given rise to the need to secure hard currencies from exports in addition to the other foreign exchange resources in Egypt. In fact, the performance of the Egyptian economy during either periods of high or low growth rates, was very closely linked to the availability of foreign exchange resources in Egypt. Several factors have nevertheless contributed to the marked improvements in the foreign exchange receipts during the second half of 1970's; the four principal factors being:

i) Rapid expansion of oil output especially after the recuperation of the Sinai oil fields in 1979 in addition to exporting significant quantities of crude oil and some refined oil products. This was coupled by massive oil price rises after the Egyptian-Israeli War in 1973 which spurred the proceeds from exports of oil in oil-exporting countries in general.

ii) The re-opening of the Suez Canal for international navigation in 1974 and the completion of a project intended to widen and deepen the waterway, has resulted in a rapid growth in the foreign receipts from its operations.

iii) Remittances of foreign exchange from Egyptians working abroad especially those in the neighbouring oil-rich Arab countries.

iv) The opening of the tourism sector which had grown into an active and promising source of foreign exchange.

However, the most visible and principal factor involved in the changing structure of the Egyptian economy in the mid 1970's, was the evolution of oil as the key word to interpret and explain a great deal of the constraints and opportunities which were imposed upon and affected the country's economic performance.

Therefore, the main objective of this chapter is to discuss the rapid changes that took place within the Egyptian economy since the mid-Seventies to date within the context of an overall energy profile of Egypt. A much greater attention will nonetheless be given to the electric power sector in Egypt. In the two sections to follow (i.e., sections 2 and 3), we will attempt to place energy in Egypt in its context within the overall economy. In the fourth section, however, the electricity sector will be studied extensively so as to get a much clearer insight into the sector under examination in this thesis.

2. Impact of oil on the Egyptian economy:

Much of the commendable increase in the national GDP of Egypt has been a direct result of the expansion of oil output and exports coupled with the massive increase in the international oil prices throughout the 1970's. In the following, we will discuss the role played by the oil sector on value added, international trade and government finances.

2.1. Value added:

Table (1.1) shows the development of income in various sectors of the Egyptian economy in real terms during the period 1975 to 1987/88. The Table indicates that the contribution of the oil sector to value added has jumped from L.E. 149 million in 1975 to L.E. 1251 million in 1981/82 (at constant 1975 prices) representing an increase of over seven-fold in real terms. As shown in Table (1.2), however, the average growth rate of this sector from 1975 to 1981/82 was 53% which represents the highest growth rate by any sector during that same period. In terms of relative shares, the share of oil in total value added has increased from 2.9% in 1975 to become equal to that of the entire industrial sector in 1981/82 at 13.6% [Table (1.3)].

Nevertheless, as international prices of oil fell sharply, the significant contribution of the oil sector in total value added has diminished throughout the eighties to become around L.E. 461 million in 1987/88 while its share has dropped to 4.3% [Tables (1.1) & (1.3)]. In fact, Table (1.2) indicates that the oil sector during the period 1982/83 to 1987/88 has achieved a very low average growth rate of 2.4% per annum.

Despite its large contribution to value added until the early eighties, however, the oil sector did not make a significant direct contribution to employment. That is, the oil sector could not have affected employment to any great

Table (1.1)

GDP by Economic Activity at Constant 1975 Prices
1975 - 1987/88
(L.E. Million)

YEAR / SECTOR	1975	1976	1977	1978	1979	1980/1981	1981/1982	1982/1983	1983/1984	1984/1985	1985/1986	1986/1987	1987/1988
Commodity Sectors	2817	3095	3448	3578	4615	4742	4745	4436	4728	6026	4768	4936	5214
Agriculture	1468	1617	1728	1689	1708	1737	1755	1768	1767	1913	2091	2151	2217
Industry & Mining	888	921	950	975	1114	1154	1252	1273	1275	1680	1609	1726	1856
Petroleum	149	229	397	463	1288	1417	1251	923	1171	1835	443	434	461
Electricity	69	70	70	69	69	55	60	65	79	81	118	129	139
Construction	243	259	303	382	437	379	426	406	436	517	508	495	542
Dist'n Sectors	1036	1261	1424	1650	2065	2295	2641	2742	2795	3412	3263	3436	3604
Tran & Suez Can	258	371	416	509	670	747	840	865	837	999	n.a.	n.a.	n.a.
Trade & Finance	777	889	1007	1141	1395	1549	1801	1877	1959	2413	n.a.	n.a.	n.a.
Service Sectors	1209	1359	1403	1315	1360	1522	1793	1774	1856	2080	1677	1808	1921
Housing	209	206	207	194	194	160	175	170	169	230	n.a.	n.a.	n.a.
Public Utilities	19	19	20	20	20	14	23	23	22	30	n.a.	n.a.	n.a.
Other Services	982	1134	1177	1101	1146	1348	1594	1582	1664	1821	n.a.	n.a.	n.a.
GDP Factor Cost	5062	5714	6275	6543	8040	8560	9179	8951	9379	11519	9709	10180	10739

Source: CAPMAS [12], GDP figures deflated by WPI from the same reference

Table (1.2)

Growth of GDP by Economic Activity
for 1975-1981/82 & 1982/83-1987/88
Average Annual Growth Rates
(%)

PERIOD SECTOR	1975 to 1981/82	1982/83 to 1987/88
Commodity Sectors	9.5%	4.5%
Agriculture	3.1%	4.7%
Industry & Mining	6.0%	8.5%
Petroleum	53.4%	2.4%
Electricity	-2.0%	17.2%
Construction	10.6%	6.2%
Distribution Sectors	17.0%	6.0%
Tran,Com & Suez Canal	22.3%	n.a.
Trade & Finance	15.1%	n.a.
Service Sectors	7.1%	2.3%
Housing	-2.6%	n.a.
Public Utilities	7.7%	n.a.
Other Services	8.8%	n.a.
GDP at Factor Cost	10.6%	4.4%

Source: calculated from Table (1.1)

Table (1.3)

Value Added of Economic Sectors in the Economy
(Percentage Share of Economic Activities in GDP)
1975 - 1987/88

SECTOR / YEAR	1975	1976	1977	1978	1979	1980/1981	1981/1982	1982/1983	1983/1984	1984/1985	1985/1986	1986/1987	1987/1988
Commodity Sectors	55.6%	54.2%	54.9%	54.7%	57.4%	55.4%	51.7%	49.6%	50.4%	52.3%	49.1%	48.5%	48.6%
Agriculture	29.0%	28.3%	27.5%	25.8%	21.2%	20.3%	19.1%	19.7%	18.8%	16.6%	21.5%	21.1%	20.6%
Industry & Mining	17.5%	16.1%	15.1%	14.9%	13.9%	13.5%	13.6%	14.2%	13.6%	14.6%	16.6%	17.0%	17.3%
Petroleum	2.9%	4.0%	6.3%	7.1%	16.0%	16.6%	13.6%	10.3%	12.5%	15.9%	4.6%	4.3%	4.3%
Electricity	1.4%	1.2%	1.1%	1.1%	0.9%	0.6%	0.7%	0.7%	0.8%	0.7%	1.2%	1.3%	1.3%
Construction	4.8%	4.5%	4.8%	5.8%	5.4%	4.4%	4.6%	4.5%	4.6%	4.5%	5.2%	4.9%	5.0%
Distribution Sector	20.5%	22.1%	22.7%	25.2%	25.7%	26.8%	28.8%	30.6%	29.8%	29.6%	33.6%	33.8%	33.6%
Tran, Com & S. Canal	5.1%	6.5%	6.6%	7.8%	8.3%	8.7%	9.2%	9.7%	8.9%	8.7%	n.a.	n.a.	n.a.
Trade & Finance	15.4%	15.6%	16.1%	17.4%	17.4%	18.1%	19.6%	21.0%	20.9%	20.9%	n.a.	n.a.	n.a.
Service Sectors	23.9%	23.8%	22.4%	20.1%	16.9%	17.8%	19.5%	19.8%	19.8%	18.1%	17.3%	17.8%	17.9%
Housing	4.1%	3.6%	3.3%	3.0%	2.4%	1.9%	1.9%	1.9%	1.8%	2.0%	n.a.	n.a.	n.a.
Public Utilities	0.4%	0.3%	0.3%	0.3%	0.3%	0.2%	0.3%	0.3%	0.2%	0.3%	n.a.	n.a.	n.a.
Other Services	19.4%	19.8%	18.8%	16.8%	14.3%	15.7%	17.4%	17.7%	17.7%	15.8%	n.a.	n.a.	n.a.
GDP at Factor Cost	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: calculated from Table (1.1)

extent, since the upsurge of its share in value added was almost entirely a price induced phenomenon.

2.2. International trade:

Table (1.4) shows the development of the trade balance of the oil sector (government share) in Egypt. From the table, total exports of the sector have jumped from US$ 309 million in 1975 to US$ 3441 million in 1981; an increase of over ten-fold. During the same period, however, total imports by the oil sector have increased from US$ 374 million to US$ 641 million, thus turning a deficit of US$ 65 million in 1975 to a surplus of US$ 2.8 billion in 1981. Since 1981, not only did the oil sector have to reduce its exports due to an over-supply worldwide, international prices of oil fell sharply as well. This is evident by the fall in the value of oil exports to US$ 1563 million in 1988 which in turn had led to a reduced surplus of US$ 1167 million in 1988. Such a fall in the proceeds of oil exports has affected the country's foreign exchange receipts which relied heavily upon exports of oil. In fact, exports of oil have constituted a major share in Egypt's exports. The same Table shows that the share of oil in total exports peaked at around 70% in 1979, dropping to around 30% in 1988.

Table (1.4)

The Oil Sector in Egyptian Foreign Trade
1970, 1975, 1976, 1979-1988
(in million L.E. & million US$)

YEAR	Exports L.E.	Exports US$	Imports L.E.	Imports US$	Balance L.E.	Balance US$	% share in Xs
1970	31	79	44	110	-13	-31	n.a.
1975	124	309	150	374	-26	-65	n.a.
1976	252	631	130	325	122	306	n.a.
1979	1341	1915	179	254	1162	1661	71%
1980	2145	3064	291	411	1854	2653	60%
1981	2409	3441	453	641	1956	2800	n.a.
1982	2242	3203	528	746	1714	2457	n.a.
1983	2096	2994	567	811	1529	2183	n.a.
1984	2189	3127	562	803	1627	2324	65%
1985	2338	3340	497	710	1841	2630	69%
1986	1665	2381	278	398	1387	1983	65%
1987	634	907	203	290	431	616	23%
1988	1093	1563	277	396	816	1167	29%

NOTE: starting from 1980, the fiscal year has been changed to July. Thus, 1981 is actually 1980/81 and so forth

SOURCES:
1) Oil foreign trade data for 1970-1985 from EGPC [29]; data for 1986-88 from Central Bank of Egypt [16].
2) BOP data for 1979 & 1980 from Pearce [62]; data for 1984-88 from Central Bank of Egypt [16].

Table (1.5)

The Oil Sector and Government Revenue
1977-1980 & 1985/86, 1986/87
(L.E. million)

YEAR	Total Government Revenue	Total Petroleum Revenue	Share in total Revenue
1977	2775	337	12.1%
1978	3306	406	12.3%
1979	3684	904	24.5%
1980	5346	1772	33.1%
1985/86	15016	1343	8.9%
1986/87	15230	759	4.9%

SOURCE: data 1977-1980, from Pearce [62], data 1985/86, 1986/87, from CBE [16].

2.3. Government finances:

With respect to government finances, however, the oil sector has been responsible for a significant share in government revenues over a period of time. In fact, this particular type of revenue accrues in two ways. First, the government receives the transferred profits from the EGPC. Secondly, it receives indirect taxes, business taxes and returns in self-financing investment in the oil industry [62]. Table (1.5) indicates that in 1977, the oil sector realized a budgetary revenue of L.E. 337 million, i.e., representing 12% of total government revenue. In 1980 the oil revenue increased to L.E. 1772 million to represent around one third of total government revenue. By 1986/87, however, the prices as well exports of oil had declined massively which resulted, as a consequence, in a much reduced share of oil in government finances to around 5% only. The Egyptian government nonetheless, realizing the dangers of a volatile oil market, started to develop further the non-oil sources of government revenue especially those of the services sectors such as tourism and finance. This could be shown by examining Table (1.5) where one can easily notice the drop of oil revenue in absolute terms as compared to its relative contribution to total revenue.

3. Energy profile of Egypt:

In the following, we will analyse the production and consumption of primary energy in Egypt in some detail.

3.1. Energy production in Egypt:

Primary energy production in Egypt can be classified into three main categories: oil, natural gas and hydroelectricity. During the period 1975 to 1987, aggregate energy production in Egypt as indicated in Table (1.6), has increased by over 38 MTOE to reach 51 MTOE in 1987, representing an average growth rate of 13.4% per annum. Production of oil during that same period 1975-1987 has increased by around 35 MTOE representing an increase of over four-fold. Nonetheless, its relative share in total energy production has been declining gradually though remaining above the 90% mark. This decline in the share of oil production in relative terms is due to the increased production and utilization of natural gas in Egypt. The share of natural gas has increased from less than 1% in 1975 to around 8% in 1987 which accounts for the decline in the share of oil products and hydroelectricity in total production of primary energy. In fact, the share of hydroelectricity has dropped from around 5% in 1975 to 1% in 1987. This could be explained by the fact that hydroelectricity has peaked at its capacity output throughout the period and hence there has

Table (1.6)

Production of Commercial Energy in Egypt
1975 - 1987
(in 000's TOE)

YEAR	Liquids Quant	Liquids Inc	Liquids Share	Gas Quant	Gas Inc	Gas Share	Electricity Quant	Electricity Inc	Electricity Share	Total Production Quant	Total Production Inc	Total Production Share
1975	11782	---	95%	42	---	0.3%	575	---	5%	12399	---	100%
1976	16878	43%	94%	348	729%	2%	683	19%	4%	17909	44%	100%
1977	24495	45%	95%	483	39%	2%	765	12%	3%	25743	44%	100%
1978	25035	2%	94%	951	97%	4%	788	3%	3%	26774	4%	100%
1979	25709	3%	92%	1437	51%	5%	804	2%	3%	27951	4%	100%
1980	28665	11%	93%	1443	0%	5%	812	1%	3%	30921	11%	100%
1981	29840	4%	92%	1747	21%	5%	864	6%	3%	32451	5%	100%
1982	33221	11%	92%	1947	11%	5%	886	3%	2%	36054	11%	100%
1983	36451	10%	93%	1937	-1%	5%	888	0%	2%	39276	9%	100%
1984	41885	15%	92%	2540	31%	6%	889	0%	2%	45314	15%	100%
1985	45127	8%	92%	3340	31%	7%	696	-22%	1%	49164	8%	100%
1986	41202	-9%	90%	3905	17%	9%	688	-1%	2%	45795	-7%	100%
1987	46361	13%	91%	4047	4%	8%	516	-25%	1%	50924	11%	100%
Average Annual Growth Rate 1975 - 1987			13%			86%			-0.1%			13%

SOURCE: UNITED NATIONS YEARBOOK OF ENERGY STATISTICS [82].

been increased dependence on thermal-electricity generation to mitigate for the shortfall in hydro-generation as well as to satisfy the increased demand for electricity.

3.2. Primary energy consumption:

With regard to the demand for energy in Egypt, we will first proceed by presenting an overall aggregated view of consumption patterns. Then we dis-aggregate consumption by energy type and finally we will shed the light on the largest consumer of energy in Egypt, that is the electricity sector.

3.2.1. Aggregate and per capita consumption:

Table (1.7)[1] shows that during the period 1975 to 1987, the aggregate primary energy consumption in Egypt has increased from around 9 MTOE to over 23 MTOE; that is, an increase of one- and half-folds, while the average growth rate during that period was 8.3% per annum.

With respect to per capita consumption, Table (1.7) also indicates that it has increased from 248 Kgoe in 1975 to 449 Kgoe in 1987, representing an increase of 81% during that period.

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[1]The Table reports commercial energy only. Although, traditional non-commercial energy sources (e.g., dung and fire-wood) are used in many parts of Egypt in considerable quantities, there is no accurate assessment of this particular source of energy to date. Therefore, we will only deal with commercial energy throughout this thesis.

Table (1.7)

Total & Per Capita Primary
Energy Consumption in Egypt
1975 - 1987/88
(000's TOE) & (Kgoe)

YEAR	Total Conumption		Population	P/C Consumption	
	Quantity (000 TOE)	Growth Rate	(million)	Quantity (Kgoe)	Growth Rate
1975	9174	---	37.0	248	---
1976	9861	7%	38.2	258	4%
1977	10831	10%	38.8	279	8%
1978	11900	10%	39.8	299	7%
1979	13184	11%	40.9	322	8%
1980/81	15116	15%	43.3	349	8%
1981/82	16195	7%	44.5	364	4%
1982/83	17502	8%	45.8	382	5%
1983/84	18070	3%	47.2	383	0%
1984/85	20118	11%	48.5	415	8%
1985/86	21552	7%	49.9	432	4%
1986/87	22873	6%	51.3	446	3%
1987/88	23667	3%	52.7	449	1%
Average Annual Growth Rate 1975 - 1987		8.3%			5.1%

SOURCE: 1) Energy data from United Nations [82]
2) Population data from CAPMAS [12]

Nonetheless, Figure (1.1) shows that the growth rate of the per capita energy consumption - which on average increased by 5.1% per annum from 1975 to 1987/88 - was less than that achieved by total consumption. This is due to the high rates of population growth.

Within the context of developing countries, however, Table (1.8)[2] and Figure (1.2) indicate that Egypt's per capita energy consumption was much higher than those of the other developing countries for 1981, 83, 85 and 87 except for Turkey . Despite the fact that the per capita GNP of Turkey was about twice that of Egypt, its per capita energy consumption did not exceed that of Egypt with the same proportion though it has increased by over 30% in both countries during that period. In fact, even in the case of the Philippines where its GNP per capita was more-or-less within the same bracket as that of Egypt, the latter's per capita energy consumption was much higher than that of the Philippines. That is, Egypt's per capita energy consumption was, in absolute value, more than double that of the Philippines from 1983 onwards as indicated by Table (1.8).

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[2] The figures for the per capita energy consumption only include commercial energy sources. Thus, they do not indicate the consumption of traditional energy sources (non-commercial) which are very substantial in developing countries. Nevertheless, the Table gives a comparative analysis of varying energy consumption levels amongst developing countries.

Figure (1.1)

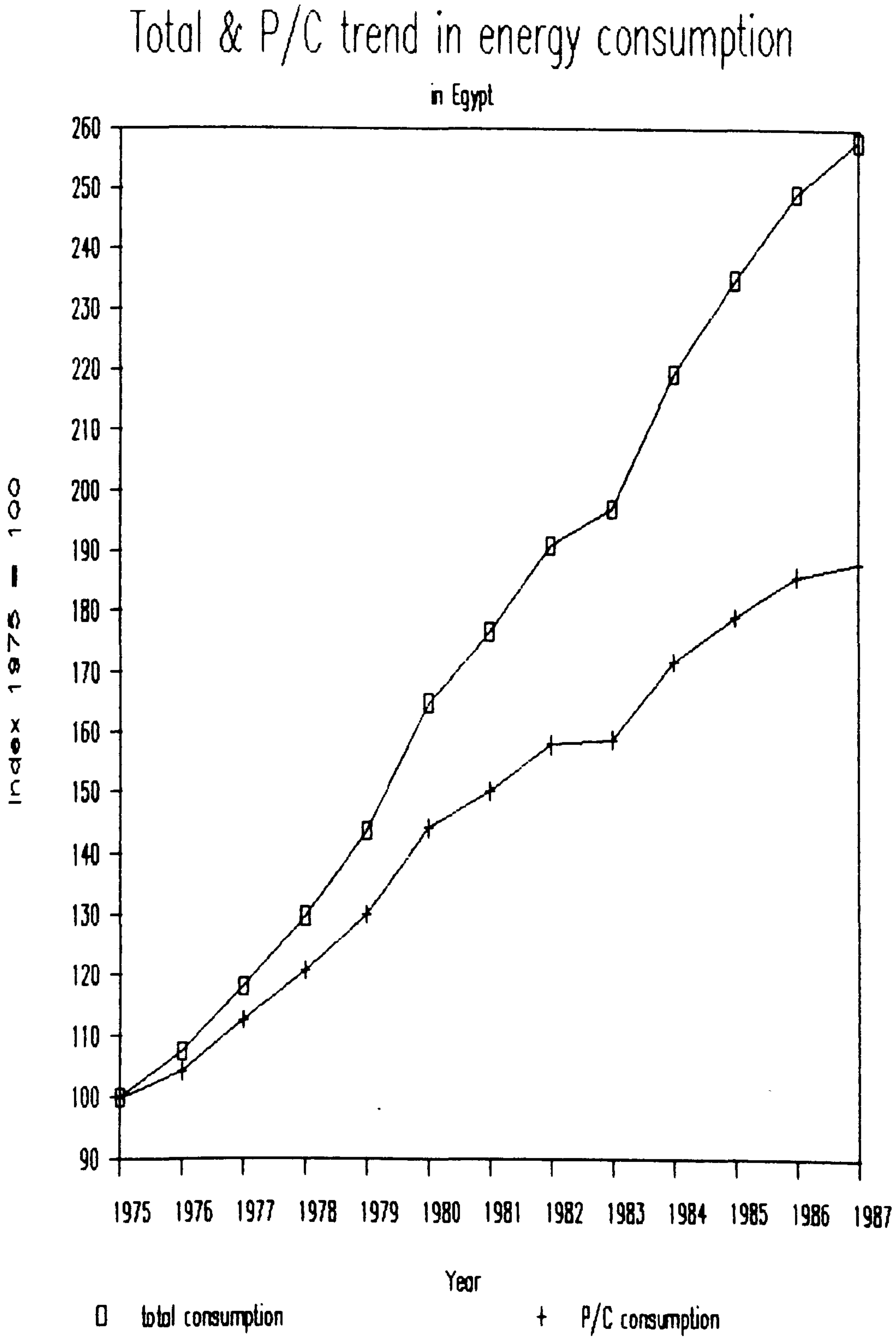

Total & P/C trend in energy consumption
in Egypt
Index 1975 = 100
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
Year
total consumption
P/C consumption

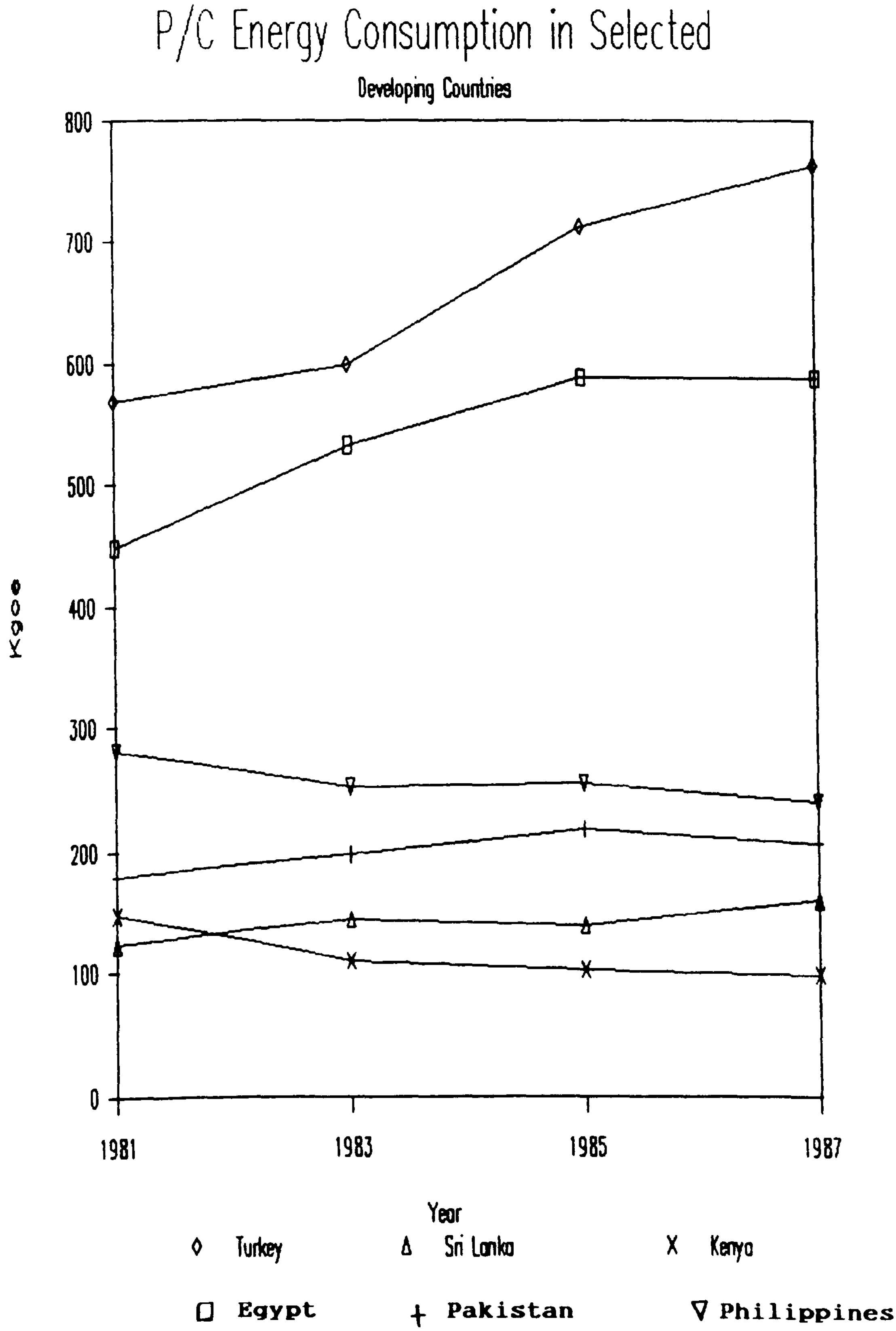
Table (1.8)

Energy GNP Intensities for selected Developing Countries in 1981, 1983, 1985 & 1987

COUNTRY \ YEAR	Per Capita GNP (US$) 1981	1983	1985	1987	Per Capita Energy Consumption (Kgoe) 1981	1983	1985	1987	Energy GNP Intensity (Kgoe/US$) 1981	1983	1985	1987
Egypt	650	700	610	680	448	532	588	588	0.69	0.76	0.96	0.86
Pakistan	350	390	380	350	179	197	218	207	0.51	0.51	0.57	0.59
Turkey	1540	1240	1080	1210	569	599	712	763	0.37	0.48	0.66	0.63
Sri Lanka	300	330	380	400	123	143	139	160	0.41	0.43	0.37	0.40
Kenya	420	340	290	330	147	109	103	99	0.35	0.32	0.36	0.30
Philippines	790	760	580	590	281	252	255	241	0.36	0.33	0.44	0.41

SOURCE:
the estimates for the energy GNP intensities have been arrived at through the utilization of the data on per capita GNP & per capita energy consumption published in the World Development Reports [91]. In the process of calculation, however, population figures cancel out.

Figure (1.2)


P/C Energy Consumption in Selected
Developing Countries
800
700
600
500
400
300
200
100
0
Kgoe
1981
1983
1985
1987
Year
◊ Turkey
Δ Sri Lanka
X Kenya
□ Egypt
+ Pakistan
∇ Philippines

3.2.2. Domestic consumption by energy type:

The components of domestic consumption of primary energy in Egypt are: oil products, natural gas, coal and hydro-electricity[3] as presented in Table (1.9). By examining the Table, we can clearly observe that oil products represent a major share in the aggregate primary energy consumption in Egypt. Despite the fact that its consumption has increased from about 7.6 MTOE in 1975 to 18.3 MTOE in 1987, its share relative to the other energy sources has declined from 83% to around 78% during the same period. This relative decline in the oil share is largely due to the increased utilization of natural gas whose domestic production started in 1975 though in small quantities as shown in the Table. However, since the mid 1970's natural gas utilization has begun to assume a much greater importance within domestic energy consumption in Egypt. In fact, it has substituted oil products in domestic uses especially in the household sector in addition to substituting coal in industry. Moreover, it has been increasingly relied upon in thermal-electricity generation as we shall discuss later. In

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[3]The consumption figures for natural gas and hydro-electricity are equal to those for production in Table (1.6). This is an over-simplistic proposition since in practice distribution and transmission losses are usually encountered in the consumption of natural gas and electricity respectively. However, this simplified assumption will be ignored since we are only using those figures for illustrative and comparative purposes only. Nevertheless, the issue of transmission losses in electricity will be discussed later.

Table (1.9)

Consumption of Commercial Energy in Egypt
1975 - 1987
(in 000's TOE)

Year	Liquids			Gas			Solids			Electricity			Total Consumption		
	Quant	Grow	Share	Quant	Grow	Share	Quant	Grow	Share	Quant	Grow	Share	Quant	Grow	Share
1975	7634	--	83%	42	--	0%	923	--	10%	575	--	6%	9174	--	100%
1976	8239	8%	84%	348	729%	4%	592	-36%	6%	683	19%	7%	9861	7%	100%
1977	8929	8%	82%	483	39%	4%	658	11%	6%	765	12%	7%	10831	10%	100%
1978	9643	8%	81%	951	97%	8%	518	-21%	4%	788	3%	7%	11900	10%	100%
1979	10741	11%	81%	1437	51%	11%	202	-61%	2%	804	2%	6%	13184	11%	100%
1980	12389	15%	82%	1443	0%	10%	471	133%	3%	812	1%	5%	15116	15%	100%
1981	12834	4%	79%	1747	21%	11%	750	59%	5%	864	6%	5%	16195	7%	100%
1982	13835	8%	79%	1947	11%	11%	835	11%	5%	886	3%	5%	17502	8%	100%
1983	14660	6%	81%	1937	-1%	11%	585	-30%	3%	888	0%	5%	18070	3%	100%
1984	16033	9%	80%	2540	31%	13%	656	12%	3%	889	0%	4%	20118	11%	100%
1985	16786	5%	78%	3340	31%	15%	729	11%	3%	696	-22%	3%	21552	7%	100%
1986	17549	5%	77%	3905	17%	17%	730	0%	3%	688	-1%	3%	22873	6%	100%
1987	18343	5%	78%	4047	4%	17%	761	4%	3%	516	-25%	2%	23667	3%	100%
Average Annual Growth Rate 1975 - 1987		8%			86%			8%			-0.1%			8%	

Source: United Nations Yearbook of Energy Statistics [82] abstract terms, its consumption has increased from 42000 TOE in 1975 to 4 MTOE in 1987 representing a striking increase of almost one hundred-fold during that period. In relative terms, however, its share in total domestic energy consumption has risen from 0.5% in 1975 to around 17% in 1987 to be ranked second to oil products with respect to relative shares in total consumption.

The third component of primary energy consumption is coal which is primarily used in the iron and steel industry in Egypt. Its consumption is therefore positively related to the state of the iron and steel industry while negatively related to its substitution by natural gas. From Table (1.9) the consumption of coal has declined from around 1 MTOE in 1975 to around 0.7 MTOE in 1987; a drop of almost 30%. In relative terms its share in total consumption has also declined from around 10% in 1975 to 3.2% in 1987.

With regard to the final component of primary energy consumption, i.e., hydro-electricity, we need to elaborate more on the declining trend it exhibits in Table (1.9). Hydroelectricity as a source of primary energy in Egypt has decreased from 6.3% of all energy consumed in 1975 to 2.2% in 1987 despite the fact that its contribution remained more-or-less the same throughout that period. In fact, not only has hydropower reached its maximum capacity, further investment in it will not make any significant contribution to electricity generation at present.

3.2.3. Demand for fossil fuel by the electricity sector:

While the potential of hydropower to expand its maximum capacity has become virtually nonexistent, the demand for electricity in Egypt, as will be discussed later, has been increasing quite dramatically in the last two decades or so. Therefore, the shortfall in hydropower has meant an increased reliance on thermal generation, i.e., oil products and natural gas in order to meet the increasing trend in electricity consumption in Egypt.

In fact, a significant proportion of the demand for primary energy originates in the electric power sector. As previously mentioned, there is a strong positive relationship existing between the demand for oil products and natural gas on the one hand and the rapidly increasing demand for electricity in Egypt on the other. Table (1.10) presents the data for the consumption of oil products and natural gas by the electricity sector in Egypt. The Table indicates that the electricity sector alone has accounted for 16% of the aggregate consumption of gas oil, fuel oil and natural gas in 1975 which increased to 33% in 1987. With respect to gas oil, however, its consumption by the electricity sector has dwindled from 11% in 1975 to 4% of the total consumption of gas oil in Egypt in 1987. In the case of fuel oil, which is considered the main fuel in thermal electricity generation, the share of electricity in its consumption has significantly

Table (1.10)

Consumption of Petroleum Products by the
Electricity Sector in Egypt
1975, 1977-1987
(000's metric tonnes)

	1975	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Gas Oil	209	17	67	153	269	522	665	778	891	465	133	175
Growth Rate	---	---	294%	128%	76%	94%	27%	17%	15%	-48%	-71%	32%
total cons	1962	1472	1697	1962	2275	2874	3175	3618	4127	4058	3849	3988
Share in total	11%	1%	4%	8%	12%	18%	21%	22%	22%	11%	3%	4%
Fuel Oil	942	1558	1341	2052	2017	2310	2705	3170	3339	3647	3532	4299
Growth Rate	---	65%	-14%	53%	-2%	15%	17%	17%	5%	9%	-3%	22%
total cons	3623	4254	4406	4940	5145	5858	6512	7222	7722	7860	7438	8114
Share in total	26%	37%	30%	42%	39%	39%	42%	44%	43%	46%	47%	53%
Natural Gas	n.a.	n.a.	n.a.	93	531	651	851	1463	1934	2811	3523	3750
Growth Rate	n.a.	n.a.	n.a.	---	471%	23%	31%	72%	32%	45%	25%	6%
total cons	n.a.	n.a.	n.a.	851	1578	1828	2035	3019	3030	3692	4229	4525
Share in total	n.a.	n.a.	n.a.	11%	34%	36%	42%	48%	64%	76%	83%	83%
Grand Total	1151	1575	1408	2298	2817	3483	4221	5411	6164	6923	7188	8224
Agg Cons	7290	8640	9504	10733	12939	14850	16510	18477	20434	20624	21833	24732
Share in Agg	16%	18%	15%	21%	22%	23%	26%	29%	30%	34%	33%	33%

SOURCES:

1) Pearce-Whitman-Peida Report [62].
2) EGPC Annual Reports [29].
3) CBE Annual Reports [16].
4) EEA Annual Reports of Electricity Statistics [25].

increased from 26% in 1975 to 53% of the total consumption of fuel oil in Egypt in 1987. Similarly, the share of natural gas in electricity consumption has increased from only 11% in 1979[4] to a striking 83% of total natural gas consumption in Egypt in 1987.

However, such an outcome has important implications with respect to the efficiencies of thermal-generation which involve losses in transforming primary energy (oil and natural gas) into secondary energy (electricity). In fact, the electricity authorities in Egypt (EEA) have been effortlessly trying to make improvements in the rates of fuel consumption of thermal generation and hence the thermal efficiency has gradually increased from around 25% in 1976 to over 31% in 1987 [25]. Therefore, policy-makers or indeed any group responsible for making investment decisions in the power sector, also have to acknowledge the very high efficiency rates of hydro-generation as opposed to those of thermal efficiency. In 1987, the average efficiency of the High Dam as well as the Aswan Dam I had, in fact, reached 83%, while it reached 91% for that of the Aswan Dam II [25].

Besides thermal generation inefficiencies, however, the ever increasing reliance on fossil fuels for electricity generation limits the volume of oil available for exports and hence affects the countries finances and foreign exchange earnings. In fact, generating electricity by using hydro-power makes a great deal of savings in terms of fuel that

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[4]Data on natural gas prior to 1979 is not readily available.

would have been used in thermal electricity generation. For instance, hydro-generation made fuel savings in 1985, to the value[5] of around L.E. 53 million which dropped[6] in 1987 to L.E. 41 million [25]. Furthermore, the increased utilization of oil and natural gas by the electric power sector, places pressures on the depletable indigenous energy resources. Finally, the dramatic increase in using oil and natural gas in generating electricity spawns yet further problems to the environment. This is demonstrated by the fact that thermal power stations emit greenhouse gases in the form of mainly CO_2 and SO_2. The latter can have a damaging effect on the environment in terms of health bills at the national level and the former contributes to environmental problems at the global level such as global warming and sea level rise.[7]

Since the bulk of the ever increasing consumption of fossil fuel is brought about by electricity generating, we are deemed to believe that the most effective method to curb this massive demand for oil and natural gas is by controlling the growth of the electricity industry in Egypt; that is, unless the hydroelectricity potential is increased or an alternative non-thermal base is developed as a source for electricity generation such as nuclear energy.

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[5]That is, calculated by using the subsidized domestic prices at which fuel is sold to the electricity sector.

[6]Mainly due to an improvement in fuel consumption rates (thermal efficiency).

[7]More details of the impacts on the environment will be given in Appendix A2.

3.3. Energy consumption vs economic growth:

In the following, we will address the issue in which energy is and has been used in Egypt. Table (1.11) indicates that in 1975 a domestic consumption of 9.2 MTOE was needed to sustain a GDP of L.E. 5062 million. The comparable figures for 1987 were 23.7 MTOE and L.E. 10739 million (at 1975 prices). The GDP/energy ratio[8] was L.E. 552 in 1975. Since then, the ratio has declined steadily from its 1975 level ending up at L.E. 454 in 1987 as shown in Table (1.11). Such a decline in the GDP/energy ratio which was around 18% during that period may suggest a declining efficiency with which energy is utilized. However, the same observations can be made on examining the energy GDP intensities[9] which are also presented in Table (1.11) as well as Figure (1.3). The Table shows an increasing trend from 1.8 Kgoe/L.E. in 1975 to 2.2 Kgoe/L.E. in 1987; an increase of over 22%. In fact, this increase in the energy intensity (and hence the decline in the GDP/energy ratio) suggests a decline in energy efficiency which is characteristic of a developing country in the process of industrialization [41]. Table (1.8)[10], nonetheless, presents energy intensities for another five

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[8]Defined as the value of GDP at constant prices per tonne of oil equivalent domestically consumed.

[9]That is, the ratio of domestic energy consumption to GDP at constant prices.

[10]GNP figures were used as a proxy for GDP since data on the latter was not readily available for the other developing countries.

Table (1.11)

Energy Ratio and Energy Intensity
in Egypt
1975 - 1987/88

YEAR	Real GDP* L.E. M.	Growth Rate (%)	Energy Cons. 000 TOE	Growth Rate (%)	Energy Ratio** L.E./TOE	Growth Rate (%)	Energy intensity Kgoe/L.E	Growth Rate (%)
1975	5062	---	9174	---	552	---	1.8	---
1976	5714	13%	9861	7%	579	5%	1.7	-5%
1977	6275	10%	10831	10%	579	-0%	1.7	0%
1978	6543	4%	11900	10%	550	-5%	1.8	5%
1979	8040	23%	13184	11%	610	11%	1.6	-10%
1980/81	8560	6%	15116	15%	566	-7%	1.8	8%
1981/82	9179	7%	16195	7%	567	0%	1.8	0%
1982/83	8951	-2%	17502	8%	511	-10%	2.0	11%
1983/84	9379	5%	18070	3%	519	1%	1.9	-1%
1984/85	11519	23%	20118	11%	573	10%	1.7	-9%
1985/86	9709	-16%	21552	7%	450	-21%	2.2	27%
1986/87	10180	5%	22873	6%	445	-1%	2.2	1%
1987/88	10739	5%	23667	3%	454	2%	2.2	-2%
Average Annual Growth Rate		7%		8%		-1%		2%

* GDP at constant 1975 prices
** is defined as the value of real GDP domestically consumed per tonne of oil equivalent

SOURCES: 1) Real GDP from Table (1.1)
2) Aggregate energy consumption from Table (1.7)

Figure (1.3)

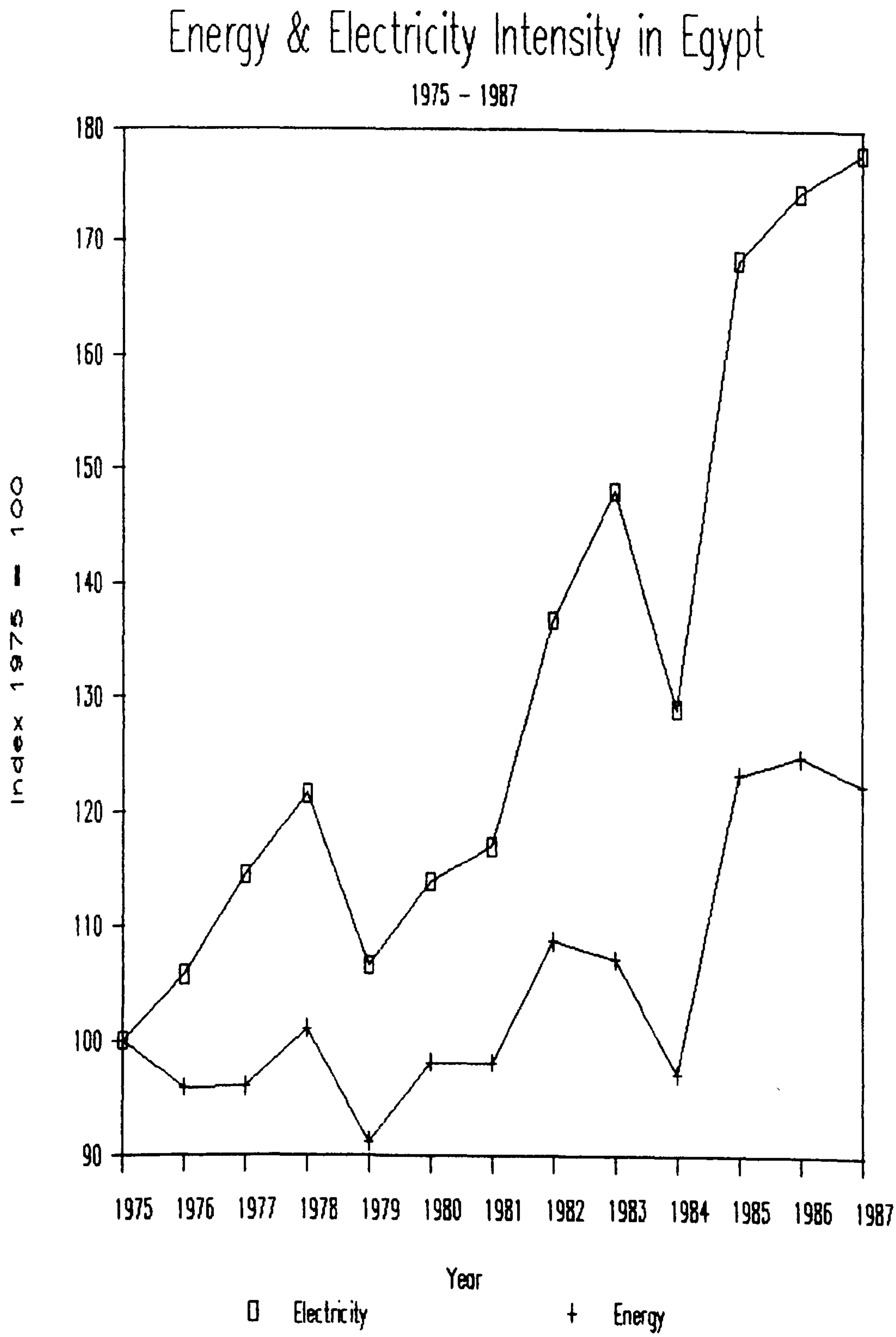
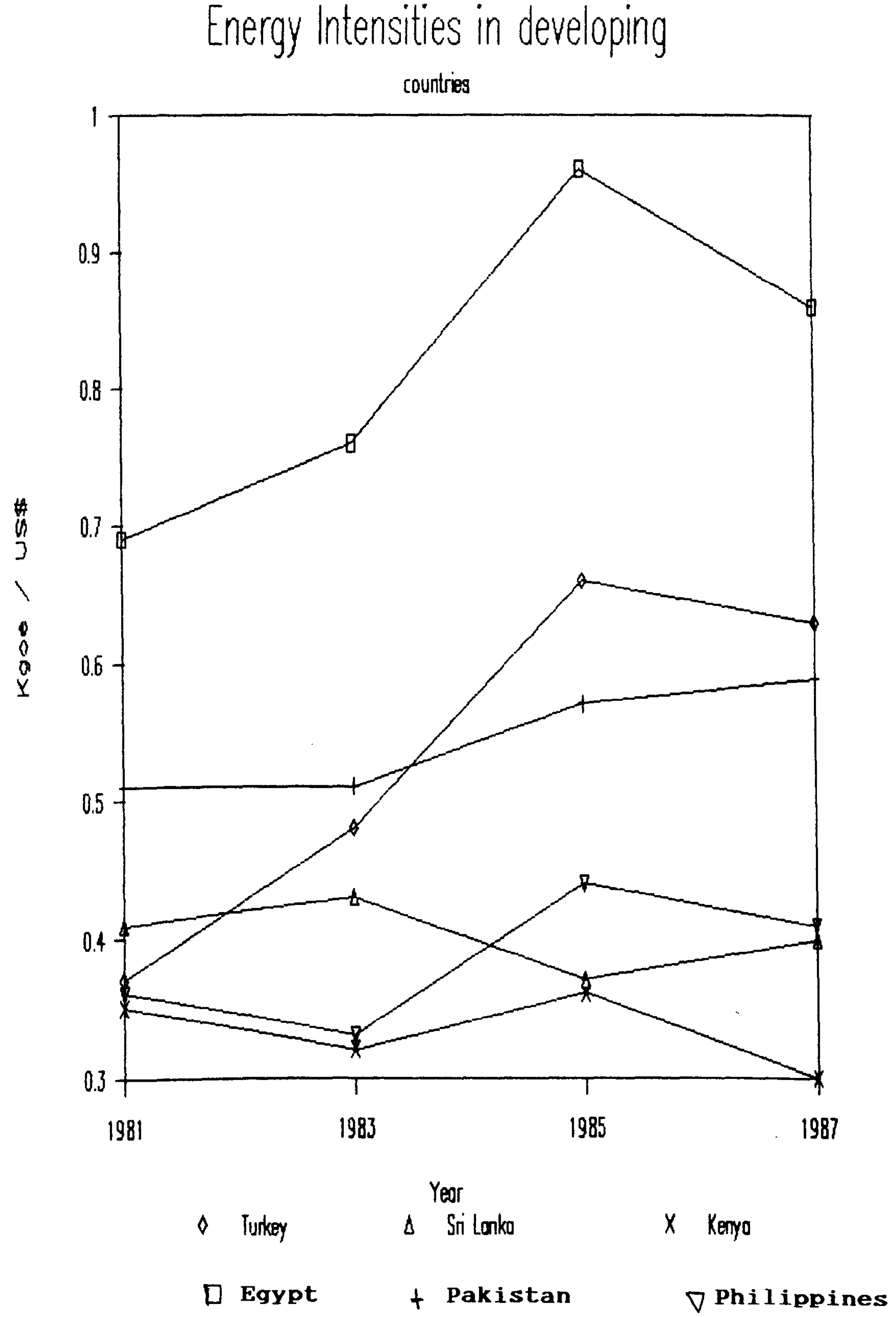

Energy & Electricity Intensity in Egypt
1975 - 1987
Index 1975 = 100
180
170
160
150
140
130
120
110
100
90
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
Year
Electricity
Energy

Figure (1.4)


Energy Intensities in developing
countries
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
Kgoe / US$
1981
1983
1985
1987
Year
Turkey
Sri Lanka
Kenya
Egypt
Pakistan
Philippines

developing countries.[11] From the Table, it is clear that the countries - except for Kenya and Sri Lanka - exhibit an increasing trend in energy intensity. However, the same Table indicates that Egypt's energy intensity was the highest amongst the other developing countries to the extent that it was even higher than that of Turkey whose per capita GNP is the highest within that group. In fact, Egypt's energy intensity has increased by around 25%, that is, from 0.69 Kgoe/US$ in 1981 to 0.86 Kgoe/US$ in 1987. The trend of energy intensities is also depicted in Figure (1.4).

4. Electricity in Egypt:

This section discusses the electricity industry in Egypt with respect to its supply and demand. We will attempt to analyse the sectoral use of electricity consumption and then we will proceed to discuss the issues involved in economic growth coupled with electricity consumption. We will also try to estimate the price and income elasticities of electricity consumption. Finally we deal with electricity intensity within the context of other developing countries.

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[11]The GNP figures in this Table are converted into US$ by using the official exchange rates. However, there is reason to believe that those official exchange rates are not realistic since most of the developing countries over-value their currencies. Moreover, there is usually multiple official exchange rates in addition to the realistic unofficial rate. Hence, one must be very cautious in interpreting the figures for the per capita GNP and consequently the intensities. However, the Table gives an insight on the varying intensities amongst developing countries in general.

4.1. Electricity supply:

In Egypt, electricity is supplied by both hydro- and thermal-generation. Table (1.12) shows the relative contribution of each source in total electricity generation during the period 1972 to 1988. In addition to the Table, in our previous analysis of energy supply in Egypt in section 3.1 and Table (1.6), we were able to illustrate that the contribution of hydroelectricity had increased only until the early 1980's then it declined afterwards as it reached its maximum capacity. The same observation could be arrived at by examining Table (1.12) where it indicates that hydroelectricity generation has increased from some 5000 GWH in 1972 to a peak of almost 10500 GWH in 1982, after which it began to decline to reach 8500 GWH in 1988. Thermal-generation, on the other hand, has exhibited a steep increase during the same period. In fact, it supplied 2225 GWH in 1972 which increased substantially to reach 29600 GWH in 1988. In relative terms, however, the share of hydropower peaked in 1974 at 72% of total generation, declining afterwards to assume equal importance with thermal-generation in 1981, but yet again dwindling further to reach only 22% in 1988.

Within the same context, the generation capacity of electricity remained significantly in excess of maximum demand till the late 1970's. As indicated by Table (1.13), the installed capacity in 1972, well exceeded maximum demand by three-fold. However, this was not sustained into later

Table (1.12)

Electricity Generation in Egypt
1972-1988
(in GWH)

YEAR	Hydro (GWH)	Share (%)	Thermal (GWH)	Share (%)	Total (GWH)	growth rate
1972	5159	70%	2225	30%	7384	---
1973	5155	69%	2279	31%	7434	1%
1974	6122	72%	2397	28%	8519	15%
1975	6790	69%	3009	31%	9799	15%
1976	8003	69%	3643	31%	11646	19%
1977	9047	67%	4479	33%	13526	16%
1978	9935	66%	5078	34%	15013	11%
1979	9465	58%	6751	42%	16216	8%
1980/81	9687	53%	8629	47%	18316	13%
1981/82	10091	49%	10532	51%	20623	13%
1982/83	10484	45%	12869	55%	23353	13%
1983/84	9817	38%	16063	62%	25880	11%
1984/85	9633	33%	19416	67%	29049	12%
1985/86	8663	28%	22795	72%	31458	8%
1986/87	9281	28%	24183	72%	33464	6%
1987/88	8658	23%	28237	77%	36895	10%
1988/89	8500	22%	29600	78%	38100	3%

SOURCE: EEA Annual Electricity Statistics [25].

Table (1.13)

Installed Capacity, Maximum Demand
& Capacity Reserve Margins
1972 - 1987/88

YEAR	Installed Capacity (MW) Hydro	(%)	Thermal	(%)	Total	(%)	Maximum Demand (MW)	Reserve Margin* (%)
1972	2445	65%	1330	35%	3775	100%	1176	221%
1973	2445	65%	1330	35%	3775	100%	1248	202%
1974	2445	65%	1330	35%	3775	100%	1433	163%
1975	2445	65%	1330	35%	3775	100%	1733	118%
1976	2445	65%	1344	35%	3789	100%	1909	98%
1977	2445	63%	1415	37%	3860	100%	2284	69%
1978	2445	63%	1460	37%	3905	100%	2564	52%
1979	2445	58%	1784	42%	4229	100%	2829	49%
1980/81	2445	52%	2286	48%	4731	100%	3239	46%
1981/82	2445	50%	2469	50%	4914	100%	3553	38%
1982/83	2445	48%	2685	52%	5130	100%	3900	32%
1983/84	2445	41%	3565	59%	6010	100%	4376	37%
1984/85	2445	35%	4538	65%	6983	100%	4880	43%
1985/86	2670	32%	5638	68%	8308	100%	5279	57%
1986/87	2745	32%	5898	68%	8643	100%	5742	51%
1987/88	2745	31%	6218	69%	8963	100%	6152	46%

* Capacity reserve margins are calculated as:
  (Installed capacity - maximum demand) / maximum demand.

SOURCE: EEA Annual Reports of Electricity Statistics [25] years as the installed capacity did not expand at the same rate as maximum demand. This is translated by a significant drop in the gross reserve margin which reached 46% in 1987 declining from 221% in 1972 as indicated by Table (1.13). Nevertheless, this decline in the reserve margin entails a reduced spare capacity available to cover maintenance, outage and breakdowns. On the other hand, an excess generating capacity, i.e., in excess of reserve margins that allow only for derating of plant due to age, hydrology and operating conditions, can have serious implications in terms of investment inefficiencies as we shall highlight later on.

4.2. Demand for electricity:

In our previous discussion of the demand for oil products and natural gas, we showed that a significant proportion of the primary energy demand in Egypt originates in the electric power sector. In fact, we were able to show that one third of the total consumption of oil and natural gas in 1987 was accounted for by the electricity sector.

Table (1.14) shows that total electricity consumption in Egypt has increased from around 6.9 billion KWH in 1974 to 31.7 billion KWH in 1988/89 representing an increase of almost four-fold. The average rate of growth of total electricity consumption was around 12% per annum over the period 1974 to 1988/89.

Table (1.14)

Electricity Consumption in Egypt by Major Economic Sectors
1974 - 1987/88
(in GWH)

YEAR	Industry			Agriculture			Residential			Others			Total Consumption		
	Quantity (GWH)	Growth Rate	Share (%)	Quantity (GWH)	Growth Rate	Share (%)	Quantity (GWH)	Growth Rate	Share (%)	Quantity (GWH)	Growth Rate	Share (%)	Quantity (GWH)	Growth Rate	Share (%)
1974	3789	13%	55%	684	5%	10%	923	40%	13%	1499	14%	22%	6895	12%	100%
1975	4804	27%	58%	677	-1%	8%	1148	24%	14%	1679	12%	20%	8308	20%	100%
1976	5847	22%	61%	671	-1%	7%	1374	20%	14%	1769	5%	18%	9662	16%	100%
1977	7180	23%	62%	698	4%	6%	1685	23%	15%	1926	9%	17%	11489	19%	100%
1978	7553	5%	59%	697	-0%	5%	2197	30%	17%	2276	18%	18%	12723	11%	100%
1979	7800	3%	57%	720	3%	5%	2670	22%	19%	2510	10%	18%	13700	8%	100%
1980/81	9186	18%	59%	777	8%	5%	3583	34%	23%	2045	-19%	13%	15591	14%	100%
1981/82	9593	4%	56%	836	8%	5%	4373	22%	25%	2364	16%	14%	17166	10%	100%
1982/83	10270	7%	52%	942	13%	5%	5484	25%	28%	2941	24%	15%	19637	14%	100%
1983/84	11494	12%	51%	1048	11%	5%	6816	24%	31%	2973	1%	13%	22331	14%	100%
1984/85	11758	2%	49%	1108	6%	5%	7762	14%	33%	3134	5%	13%	23762	6%	100%
1985/86	12758	9%	49%	1197	8%	5%	8850	14%	34%	3358	7%	13%	26163	10%	100%
1986/87	13894	9%	49%	1166	-3%	4%	9755	10%	34%	3696	10%	13%	28511	9%	100%
1987/88	14710	6%	48%	1221	5%	4%	10824	11%	35%	3790	3%	12%	30545	7%	100%
1988/89	15220	3%	48%	1303	7%	4%	11157	3%	35%	4010	6%	13%	31690	4%	100%
Average annual growth rate		11%			5%			21%			8%			12%	

NOTE: percentages do not add up due to rounding off.

SOURCE: EEA Annual Reports of Electricity Statistics [25], several issues.

However, the profile of electricity demand in Egypt was more geared towards the productive sectors of the economy, namely the industrial and agriculture sectors. In fact, the high growth rate of electricity consumption during the seventies as shown in Table (1.14) could be attributed to the massive industrial consumption which dominated electricity consumption in Egypt. Nonetheless, this trend has been declining in the last decade or so as indicated by the same table whereby both the industrial and agricultural sectors consumed 65% of total electricity consumption in Egypt in 1974 which declined gradually until reaching 52% in 1988/89. On the other hand, it is clear from the same Table that the share of domestic and services sectors in total electricity consumption has increased during the same period. In specific, the share of the residential and commercial sectors has increased from 13% in 1974 to 35% in 1988/89 at an average growth rate of 21% per annum.

In fact, not only was the industrial demand for electricity responsible for the substantial growth in electricity consumption throughout the seventies, only two industries (namely: The Kima Fertilizer and the Aluminium plants) have accounted for the bulk of electricity consumption in the last two decades as will be shown in chapter 3.

In terms of per capita electricity consumption, Table (1.15) indicates that it has increased from 190 KWH in 1974 to 585 KWH in 1988/89; an increase of around 208% in abstract

Table (1.15)

Total & P/C Electricity Consumption
in Egypt
1974 - 1988/89
(GWH) & (KWH)

Year	Total Conumption: Quantity (GWH)	Total Conumption: Growth Rate	Population (millions)	P/C consmption: Quantity (KWH)	P/C consmption: Growth Rate
1974	6895	12%	36.2	190	---
1975	8308	20%	37.0	225	18%
1976	9662	16%	38.2	253	13%
1977	11489	19%	38.8	296	17%
1978	12723	11%	39.8	320	8%
1979	13700	8%	40.9	335	5%
1980/81	15591	14%	43.3	360	7%
1981/82	17166	10%	44.5	386	7%
1982/83	19637	14%	45.8	429	11%
1983/84	22331	14%	47.2	473	10%
1984/85	23762	6%	48.5	490	4%
1985/86	26163	10%	49.9	524	7%
1986/87	28511	9%	51.3	556	6%
1987/88	30545	7%	52.7	580	4%
1988/89	31690	4%	54.2	585	1%
Average annual growth rate		10.8%			7.9%

SOURCES: 1) EEA annual reports of electricity statistics [25], for consumption figures
2) CAPMAS statistical yearbooks [12], for data on population

terms which is less than the increase in total electricity consumption as shown in Figure (1.5). This is, in fact, attributed to the high growth rates of the population which out paced the growth rates of electricity consumption during that period. In contrast to other countries, however, Table (1.16) presents the data for the per capita electricity consumption in other five developing countries in addition to Egypt. Nonetheless, on examining Figure (1.6) in addition to Table (1.16), we can make the following observations. First, the per capita electricity consumption of Egypt - which in magnitude comes second to Turkey - has during the period 1983 to 1986, exhibited the lowest growth rate of 17% as compared to those of Pakistan, Turkey and Sri Lanka of 20%, 28% and 19% respectively. Secondly, only in both Egypt and Sri Lanka was the increase in per capita electricity consumption accompanied by an increase in per capita GNP during the period 1983 to 1986.

In the following, however, we will analyse electricity consumption in relation to economic growth in Egypt.

4.3. Electricity and economic development in Egypt:

Analogous to our previous discussion in section 3.3 on energy ratios (coefficients) and intensities, we present the same analysis in the following though in terms of electricity consumption. Table (1.17) indicates that 8309 GWH of domestic electricity consumption was required to sustain

Figure (1.5)

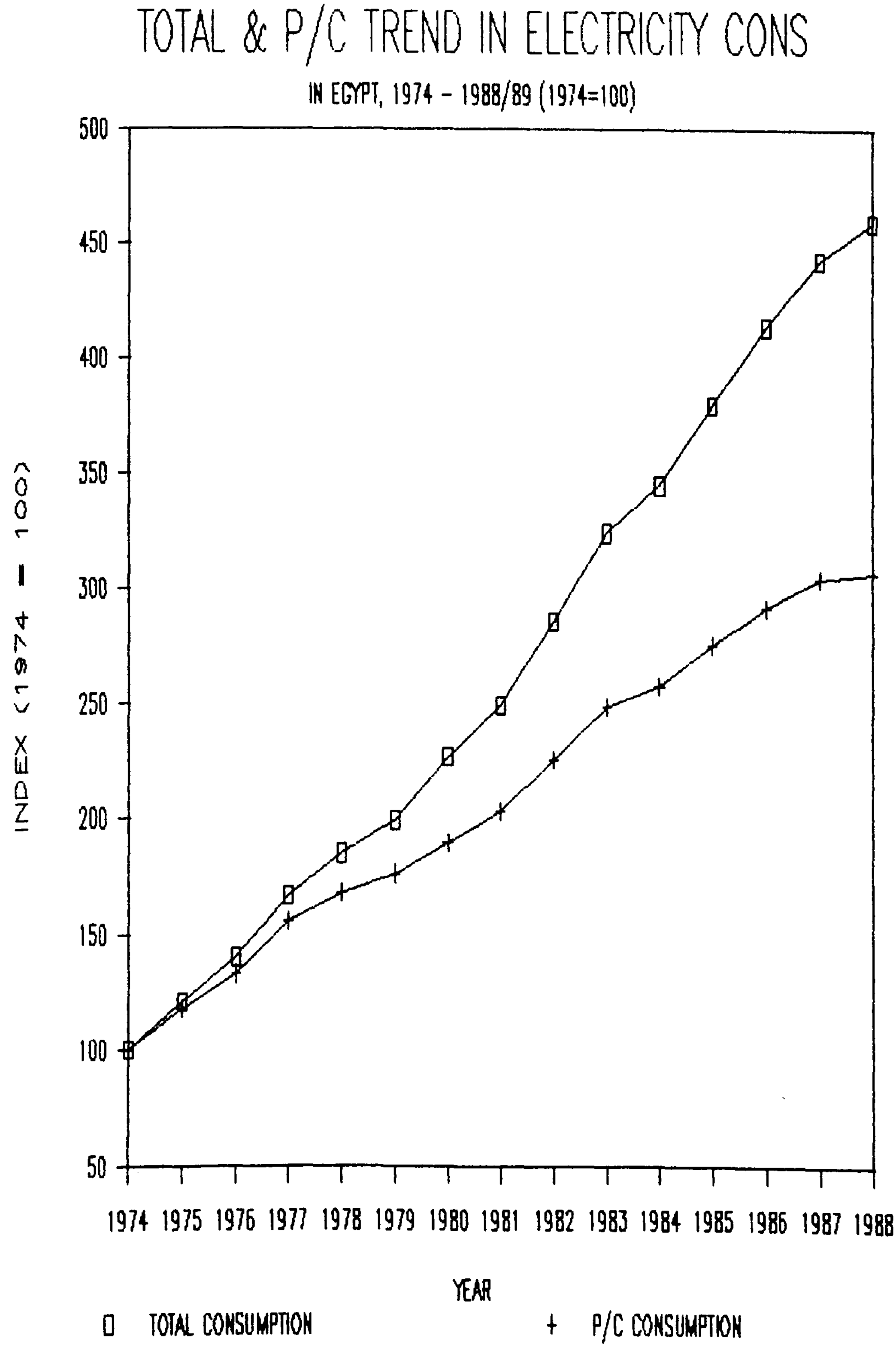
TOTAL & P/C TREND IN ELECTRICITY CONS
IN EGYPT, 1974 - 1988/89 (1974=100)
INDEX (1974 = 100)
500
450
400
350
300
250
200
150
100
50
1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988
YEAR
TOTAL CONSUMPTION
P/C CONSUMPTION

TABLE (1.16)

ELECTRICITY INTENSITIES FOR SELECTED
DEVELOPING COUNTRIES
1983 - 1986

	PER CAPITA GNP (US$)				PER CAPITA ELECTRICITY CONSUMPTION (KWH)				ELECTRICITY GNP INTENSITY (KWH/US$)			
YEAR / COUNTRY	1983	1984	1985	1986	1983	1984	1985	1986	1983	1984	1985	1986
EGYPT	700	720	610	760	473	490	524	556	0.67	0.66	0.80	0.73
PAKISTAN	390	380	380	350	208	224	229	250	0.53	0.59	0.60	0.71
TURKEY	1240	1160	1080	1110	625	690	719	804	0.50	0.59	0.67	0.72
SRI LANKA	330	360	380	400	135	142	152	161	0.40	0.39	0.40	0.40
KENYA	340	310	290	300	127	125	131	127	0.37	0.40	0.45	0.42
PHILIPPINES	760	660	580	560	412	396	420	400	0.54	0.60	0.72	0.71

SOURCES: * the values of the electricity intensities are arrived at through the data on per capita GNP & per capita energy consumption published in the World Development Reports [91]. In the process of calculation, however, the population figures cancel out.
* the data on P/C electricity consumption in Egypt was obtained from Table (1.15)

Figure (1.6)

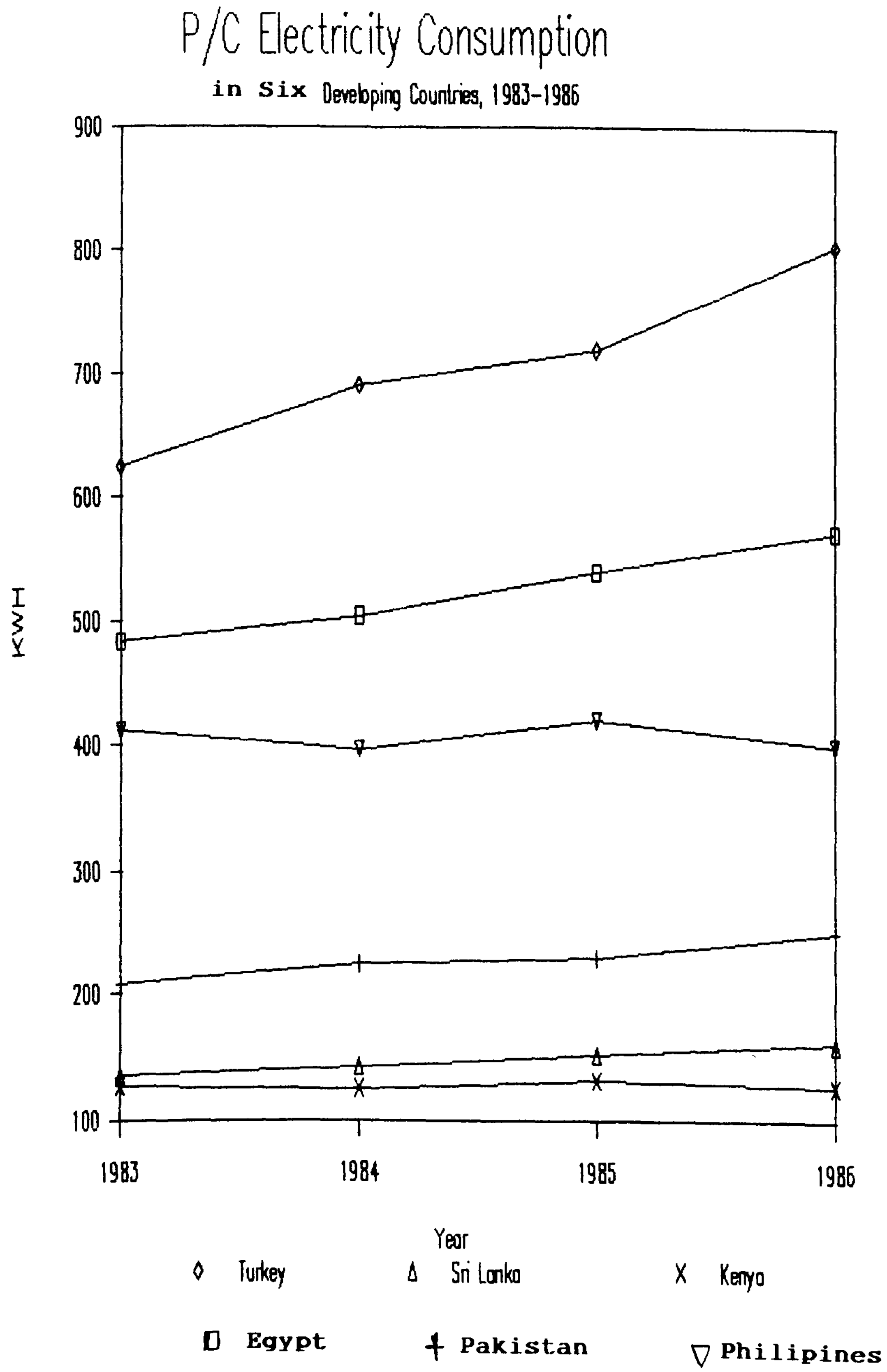
P/C Electricity Consumption
in Six Developing Countries, 1983-1986
900
800
700
600
500
400
300
200
100
KWH
1983
1984
1985
1986
Year
Turkey
Sri Lanka
Kenya
Egypt
Pakistan
Philipines

Table (1.17)

Electricity Ratio & Electricity Intensity
in Egypt
1975 - 1987/88

YEAR	Real GDP* M L.E.	Growth Rate (%)	Elect Cons GWH	Growth Rate (%)	Elect Ratio **	Growth Rate (%)	Elect Inten KWH/L.E.	Growth Rate (%)
1975	5062	---	8308	---	609	---	1.6	---
1976	5714	13%	9662	16%	591	-3%	1.7	3%
1977	6275	10%	11489	19%	546	-8%	1.8	8%
1978	6543	4%	12723	11%	514	-6%	1.9	6%
1979	8040	23%	13700	8%	587	14%	1.7	-12%
1980/81	8560	6%	15591	14%	549	-6%	1.8	7%
1981/82	9179	7%	17166	10%	535	-3%	1.9	3%
1982/83	8951	-2%	19637	14%	456	-15%	2.2	17%
1983/84	9379	5%	22331	14%	420	-8%	2.4	9%
1984/85	11519	23%	23762	6%	485	15%	2.1	-13%
1985/86	9709	-16%	26163	10%	371	-23%	2.7	31%
1986/87	10180	5%	28511	9%	357	-4%	2.8	4%
1987/88	10739	5%	30545	7%	352	-2%	2.8	2%
Average Annual Growth Rate		7%		12%		-4%		5%

NOTES:
* GDP at constant 1975 prices
** is defined as the value of real GDP per 1000 KWH of electricity domestically consumed

SOURCES:
1) Real GDP from Table (1.1)
2) Aggregate electricity consumption from Table (1.14)

a GDP of over L.E. 5 billion in 1975 which represents a ratio of L.E. 609 /1000 KWH. In 1987, nonetheless, 30573 GWH were needed to sustain a GDP of almost L.E. 11 billion; representing an electricity GDP ratio of L.E. 351 /1000 KWH. It is worth-noting, however, that the 42% fall in the electricity ratio during the period 1975 to 1987, is more than twice that of the energy ratio which fell by only 18% during the same period.

Within the same context, Table (1.17) indicates that the intensity of electricity demand in Egypt has increased from 1.6 KWH/L.E. in 1975 to 2.8 KWH/L.E. in 1987; an increase of 75%. The comparable figure for energy intensity, however, is only around 22% [Table (1.11)].

From the above argument, it is clear that the substantial increase of the electricity intensity of Egypt implies a considerable decline in efficiency with which electricity is utilized. In fact, the massive industrial consumption of electricity by largely electricity-intensive and inefficient industries (such as the Kima Fertilizer and the Aluminium plants) justifies the considerable increase in electricity intensity.

However, from the perspective of a developing country, Table (1.16) as well as Figure (1.7) compare the electricity GNP[12] intensities in five developing countries in addition

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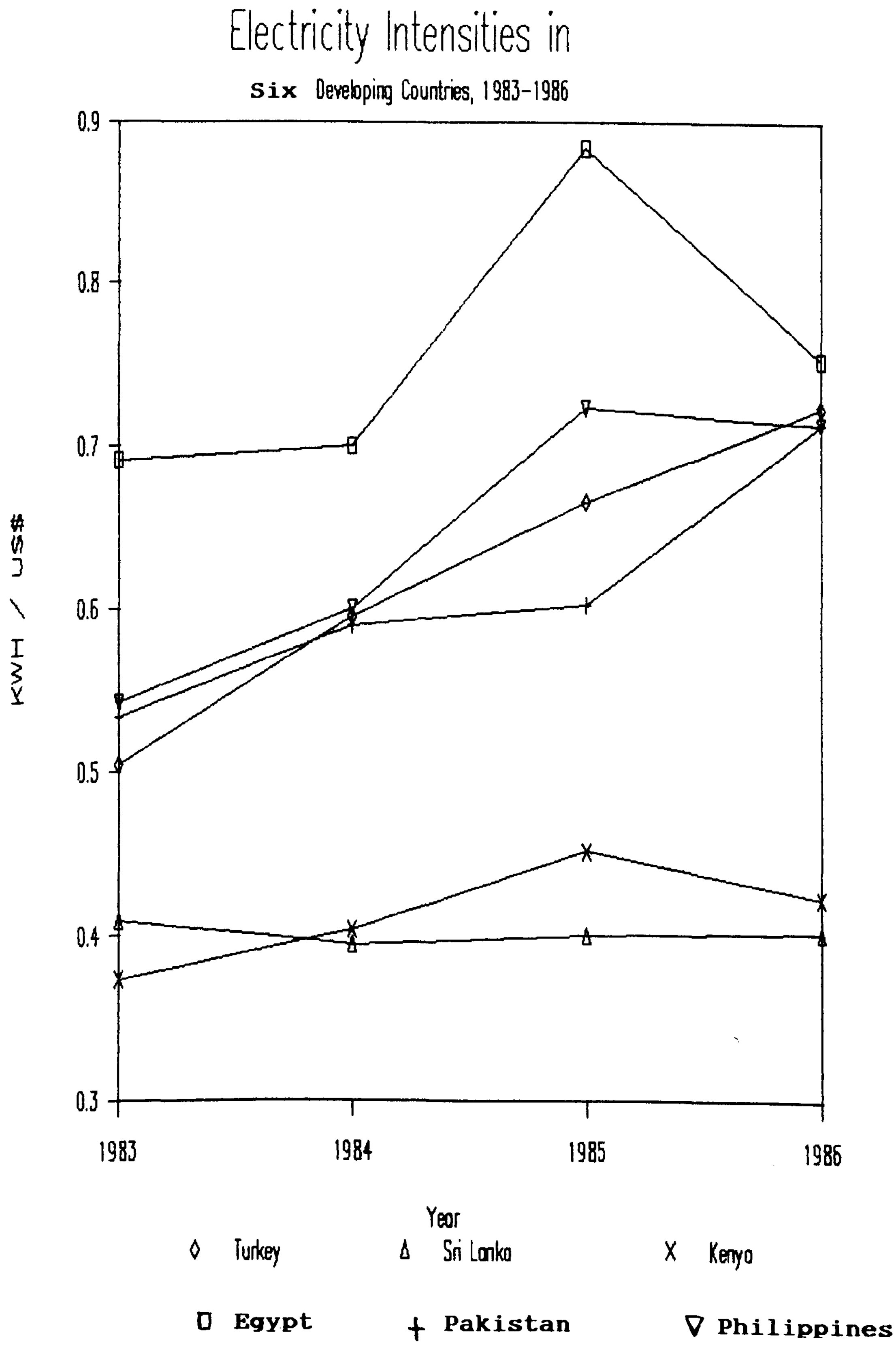
[12] Once again GNP figures are used as a proxy for GDP since the latter was not readily available. However, one has to be careful in interpreting these figures since they are all converted to the US$.

Figure (1.7)


Electricity Intensities in
Six Developing Countries, 1983-1986
0.9
0.8
0.7
0.6
0.5
0.4
0.3
KWH / US$
1983
1984
1985
1986
Year
Turkey
Sri Lanka
Kenya
Egypt
Pakistan
Philippines

to Egypt. In general, the Table indicates that all the countries cited in the Table - except for Sri Lanka - exhibit an increasing trend in their electricity intensities; a characteristic of industrialization in developing countries as well as inefficient utilization of electricity or energy in general. Nonetheless, one can make the following remarks on examining Table (1.16). First and foremost, despite that Egypt comes second to Turkey in terms of Per capita GNP, it has the highest electricity intensity within the six countries; i.e., in 1983, the Egyptian economy required 0.67 KWH to sustain one unit of product output (GNP expressed in US$) which increased to 0.73 KWH in 1986. Secondly, not only did Egypt have the highest intensity, it was the only country able to realize an increase in the per capita GNP during the period 1983 to 1986. Finally, the intensity of Egypt, though considerably high, has shown the smallest growth rate amongst the other countries - except for Sri Lanka which had more-or-less the same intensity throughout the period 1983 - 1986.

4.4. Price and income elasticities of electricity demand:

We will proceed in this section by utilizing a model for estimating the price and income elasticities of aggregate and sectoral demand of electricity in Egypt. The model is in the form of a double-logarithmic equations and the method of Ordinary Least Squares (OLS) is used to obtain estimates which will have all the desired properties. It is worth-noting that several computer programmes are already available which provide the values of t-statistics (to test whether the true values of the parameters are different from zero) and R^2 (to show the percentage out of the total variation which is explained by the independent variables. In this thesis, the Microsoft package has been used for estimation of the models.

The model for the demand is in the general form of:

$$\text{Ln } q_{it} = a_1 + a_2 \text{ Ln } P_{it} + a_3 \text{ Ln } Y_t + a_4 \text{ Ln } q_{it,-1} + u_t \qquad \text{----------(1.1)}$$

<u>where</u>:

q_{it} = electricity consumption of sector i in year t,

P_{it} = average real price of electricity faced by sector i in year t, deflated by Wholesale Price Index (WPI),

Y_t = real GDP in year t,

$q_{it,-1}$ = is a dynamic adjustment term in the model which represents lagged electricity consumption of sector i in year t.

The model will be used for estimation of electricity demand in the industrial, agricultural, and residential sectors in addition to the aggregate demand. In the cases of residential and aggregate demand, estimation of demand will allow for per capita consumption in each case whereby per capita GDP will be used instead of the total. The time-series data used in estimation are presented in Appendix A1, Tables (A1.1), and (A1.2).

In order to find out whether the oil revenues have had an effect on the income elasticity, we will consider estimation for each case under the two conditions. That is, using real value of GDP as well as the same value after deducting the oil component from it.

It is to be noted that α_2 and α_3 represent the short-term elasticities of price and income respectively. The corresponding long-term price and income elasticities are calculated as : α_2 / $(1-\alpha_4)$ and α_3 / $(1-\alpha_4)$ respectively.

Table (1.18) gives the price and income elasticities for the short- and long-run for each of the cases discussed above. In addition, the same tables provide the values of t- and F-statistics, Durbin-Watson (DW) as well as R^2.

In the case of the price elasticity being insignificant, the price variable will be deleted from the model and Table (1.19) provides the income elasticities after deleting the price variable. For comparative purposes, the income and price elasticities of the main model, are shown in the Table.

In the following, we will present the demand equations for the dynamic model of the various cases as been discussed previously. The values between paranetheses are those of the t-statistics.

Table (1.18)

Estimation Results of the Regression Equations

CATEGORY	CASE	Constant	Short-Run Elasticity Price	Short-Run Elasticity Income	Long-Run Elasticity Price	Long-Run Elasticity Income	R^2	F	DW
AGGREGATE	(a)	2.74 (2.45)	-0.13 (-1.66)	-0.29 (-1.89)	6.5	14.5	99	403	2.1
	(b)	1.97 (1.19)	-0.06 (-0.73)	-0.25 (-0.73)	1.2	5.0	99	275	1.8
AGGREGATE PER CAPITA	(a)	2.36 (2.84)	-0.11 (-1.61)	-0.34 (-2.44)	-2.2	-6.8	99	228	1.7
	(b)	1.43 (1.06)	-0.03 (-0.37)	-0.24 (-0.68)	-3.0	-24.0	98	123	1.4
INDUSTRY	(a)	1.22 (0.89)	0.01 (0.03)	-0.06 (-0.18)	0.1	-0.9	94	37	2.5
	(b)	-0.01 (-0.01)	0.04 (0.24)	0.42 (0.75)	0.1	1.0	95	40	2.6
AGRICULTURE	(a)	-1.22 (-1.26)	0.18 (0.81)	0.3 (1.60)	0.7	1.1	96	64	1.7
	(b)	-1.54 (-1.31)	0.11 (0.56)	0.46 (1.57)	0.1	0.5	96	63	1.7
RESIDENTIAL	(a)	0.45 (0.19)	-0.05 (0.23)	0.07 (0.26)	-0.6	0.8	99	403	2.4
	(b)	4.19 (1.04)	-0.11 (-0.58)	-0.45 (-0.80)	2.8	11.3	99	441	1.8
RESIDENTIAL PER CAPITA	(a)	-0.23 (-0.16)	0.01 (0.05)	0.16 (0.69)	0.1	1.6	99	391	2.5
	(b)	1.36 (0.58)	-0.06 (-0.34)	-0.15 (-0.30)	-0.9	-2.1	99	368	1.7

NOTES: 1) Case (a) denotes estimation with total GDP while Case (b) excludes the oil from GDP upon estimation

2) the values between paranethes are the t-values

Table (1.19)

Estimation Results of the Regression Equations
After Price Deletion

CATEGORY	CASE	Short-Run Elasticity Price	Short-Run Elasticity Income	Long-Run Elasticity Price	Long-Run Elasticity Income	$(R)^2$	F	DW
AGGREGATE	(1)	-0.13 (-1.66)	-0.29 (-1.89)	6.5	14.5	99	403	2.1
	(2)	----	0.12 (-0.93)	---	-12.0	99	1481	1.9
AGGREGATE*	(1)	-0.06 (-0.73)	-0.25 (-0.73)	1.2	5.0	99	275	1.8
	(2)	----	-0.14 (-0.48)	---	-7.0	99	442	2.0
AGGREGATE PER CAPITA	(1)	-0.11 (-1.61)	-0.34 (-2.44)	-2.2	-6.8	99	228	1.7
	(2)	----	-0.20 (-1.66)	---	-20.0	98	279	1.3
AGGREGATE PER CAPITA*	(1)	-0.03 (-0.37)	-0.24 (-0.68)	-3.0	-24.0	98	123	1.4
	(2)	----	-0.18 (-0.62)	---	-18.0	98	210	1.4
INDUSTRY	(1)	0.01 (0.03)	-0.06 (-0.18)	0.1	-0.9	94	37	2.5
	(2)	----	-0.06 (-0.25)	---	-1.0	94	64	2.5
INDUSTRY*	(1)	0.04 (0.24)	0.42 (0.75)	0.1	1.0	95	40	2.6
	(2)	----	0.41 (0.79)	---	1.0	95	69	2.6

CONTINUED NEXT PAGE

Table (1.19) CONT'D

Estimation Results of the Regression Equations
After Price Deletion

CATEGORY	CASE	Short-Run Elasticity: Price	Short-Run Elasticity: Income	Long-Run Elasticity: Price	Long-Run Elasticity: Income	$(R)^2$	F	DW
AGRICULTURE	(1)	0.18 (0.81)	0.3 (1.60)	0.7	1.1	96	64	1.7
	(2)	----	0.2 (1.47)	---	1.3	96	101	1.9
AGRICULTURE*	(1)	0.11 (0.56)	0.46 (1.57)	0.1	0.5	96	63	1.7
	(2)	----	0.34 (1.58)	---	1.1	96	105	1.9
RESIDENTIAL	(1)	-0.05 (0.23)	0.07 (0.26)	-0.6	0.8	99	403	2.4
	(2)	----	0.1 (0.46)	---	1.1	99	670	2.4
RESIDENTIAL*	(1)	-0.11 (-0.58)	-0.45 (-0.80)	2.8	11.3	99	441	1.8
	(2)	----	-0.39 (-0.73)	---	9.8	99	731	1.6
RESIDENTIAL PER CAPITA	(1)	0.01 (0.05)	0.16 (0.69)	0.1	1.6	99	391	2.5
	(2)	----	0.15 (0.81)	---	1.5	99	684	2.5
RESIDENTIAL PER CAPITA*	(1)	-0.06 (-0.34)	-0.15 (-0.30)	-0.9	-2.1	99	368	1.7
	(2)	----	-0.12 (-0.26)	---	-2.0	99	631	1.6

NOTES: 1) * denotes estimation with real GDP excluding the oil component
2) Case (1) represents the estimation results of the original models which include the price variable -presented in table (1.18), whereas Case (2) presents the estimation results after deleting the price
3) the values between paranethes are the t-values

1) For the <u>aggregate consumption</u>, the demand equation is:

$$\underset{(2.45)}{\text{Ln } q_1 = 2.74} \underset{(-1.66)}{+ 0.13 \text{ Ln } P_1} \underset{(-1.89)}{- 0.29 \text{ Ln } Y} \underset{(15.68)}{+ 1.02 \text{ Ln } q_{1,-1}} \qquad \text{--------(1.2)}$$

$R^2 = 99$; $F = 403$; $DW = 2.1$

<u>where</u>:

q_1 : aggregate electricity consumption

P_1 : average real price for aggregate electricity consumption

In the case of the aggregate consumption with <u>non-oil GDP</u>, the demand equation is:

$$\underset{(1.19)}{\text{Ln } q_1 = 1.97} \underset{(-0.73)}{- 0.06 \text{ Ln } P_1} \underset{(-0.73)}{- 0.25 \text{ Ln } NY} \underset{(6.03)}{+ 1.05 \text{ Ln } q_{1,-1}} \qquad \text{--------(1.3)}$$

$R^2 = 99$; $F = 275$; $DW = 1.8$

<u>where</u>:

NY : the real GDP excluding the oil component

All the other variables are defined above.

2) In the case of <u>per capita aggregate consumption</u>, the demand equation is:

$$\underset{(2.84)}{\text{Ln } qpc_1 = 2.36} \underset{(-1.61)}{- 0.11 \text{ Ln } P_1} \underset{(-2.44)}{- 0.34 \text{ Ln } PY} \underset{(16.19)}{+ 0.95 \text{ Ln } qpc_{1,-1}} \qquad \text{--------(1.4)}$$

$R_2 = 99$; $F = 228$; $DW = 1.7$

where:

qpc_1 : per capita aggregate electricity consumption

PY : per capita real GDP

For the per capita aggregate consumption with non-oil GDP, the demand equation is:

$$\underset{}{\text{Ln } qpc_1} = \underset{(1.06)}{1.43} - \underset{(-0.37)}{0.03} \text{ Ln } P_1 - \underset{(-0.68)}{0.24} \text{ Ln PNY} - \underset{(7.34)}{0.99} \text{ Ln } qpc_{1,-1} \qquad \text{-------(1.5)}$$

R_2 = 98; F = 123; DW = 1.4

where:

PNY : per capita real GDP excluding the oil component

The other variables were defined previously.

3) For electricity consumption in the industrial sector, the demand equation is:

$$\text{Ln } q_2 = \underset{(0.89)}{1.22} + \underset{(0.03)}{0.01} \text{ Ln } P_2 - \underset{(-0.18)}{0.06} \text{ Ln Y} + \underset{(3.78)}{0.93} \text{ Ln } q_{2,-1} \qquad \text{-------(1.6)}$$

R_2 = 94; F = 37; DW = 2.5

where:

q_2 : total electricity consumption of the industrial sector

P_2 : average real price of electricity supplied to the industrial sector.

In the case of the non-oil GDP in the industrial sector, the demand equation is:

$$\underset{}{\mathrm{Ln}\ q_2} = \underset{(-0.01)}{-\ 0.01} + \underset{(0.24)}{0.04}\ \mathrm{Ln}\ P_2 + \underset{(0.75)}{0.42}\ \mathrm{Ln}\ NY + \underset{(1.45)}{0.59}\ \mathrm{Ln}\ q_{2,-1} \quad \text{-------}(1.7)$$

R_2 = 95; F = 40; DW = 2.6

Where all the variables are defined in the above.

4) In the case of the agriculture sector, we obtain the following equation:

$$\mathrm{Ln}\ q_3 = \underset{(-1.26)}{-\ 1.22} + \underset{(0.81)}{0.18}\ \mathrm{Ln}\ P_3 + \underset{(1.60)}{0.30}\ \mathrm{Ln}\ Y + \underset{(3.89)}{0.73}\ \mathrm{Ln}\ q_{3,-1} \quad \text{-------}(1.8)$$

R_2 = 96; F = 64; DW = 1.7

where:

q_3 : total electricity consumption of the agricultural sector

P_3 : average real price of electricity in the agricultural sector.

For the case of agricultural consumption with non-oil GDP, we obtain the following equation:

$$\mathrm{Ln}\ q_3 = \underset{(-1.31)}{-\ 1.54} + \underset{(0.56)}{0.11}\ \mathrm{Ln}\ P_3 + \underset{(1.57)}{0.46}\ \mathrm{Ln}\ NY + \underset{(2.22)}{0.60}\ \mathrm{Ln}\ q_{3,-1} \quad \text{-------}(1.9)$$

R_2 = 96; F = 63; DW = 1.7

All the variables were defined previously.

5) In the case of electricity consumption in the <u>residential sector</u>, the demand equation is as follows:

$$\underset{}{Ln\ q_4} = \underset{(0.19)}{0.45} - \underset{(0.23)}{0.05}\ Ln\ P_4 + \underset{(0.26)}{0.07}\ Ln\ Y + \underset{(13.34)}{0.91}\ Ln\ q_{4,-1} \qquad \text{------}(1.10)$$

R_2 = 99; F = 403; DW = 2.4

<u>where</u>:

q_4 : total residential electricity consumption

P_4 : average real price of residential electricity

With regard to the case of <u>non-oil GDP</u> in the residential sector, we obtain this equation:

$$Ln\ q_4 = \underset{(1.04)}{4.19} - \underset{(-0.58)}{0.11}\ Ln\ P_4 - \underset{(-0.80)}{0.45}\ Ln\ NY + \underset{(6.67)}{1.04}\ Ln\ q_{4,-1} \qquad \text{------}(1.11)$$

R_2 = 99; F = 441; DW = 1.8

All the variables were defined previously

6) For the <u>per capita residential electricity</u>, we obtain the following equation:

$$Ln\ qpc_4 = -\underset{(-0.16)}{0.23} + \underset{(0.05)}{0.01}\ Ln\ P_4 + \underset{(0.69)}{0.16}\ Ln\ PY + \underset{(18.90)}{0.9}\ Ln\ qpc_{4,-1} \qquad \text{------}(1.12)$$

R_2 = 99; F = 391; DW = 2.5

where:

qpc_4 : per capita residential electricity consumption

PY : per capita real GDP

For the non-oil GDP, the following equation is obtained upon estimation:

$$\underset{}{Ln\ qpc_4} = \underset{(0.58)}{1.36} - \underset{(-0.34)}{0.06}\ Ln\ P_4 - \underset{(-0.30)}{0.15}\ Ln\ PNY + \underset{(10.38)}{0.93}\ Ln\ qpc_{4,-1} \qquad \text{------}(1.13)$$

R_2 = 99; F = 368; DW = 1.7

All the variables are defined above.

4.4.1. Comments on the estimation results:

i) Price elasticities:

Table (1.18) shows the short- and long-run elasticities with the t-values and the values of DW, R^2 and F-statistic for each case. From this Table, the values of R^2 indicate that the application of the model fits excellently for all the cases in general.

Regarding the signs of the elasticities, the same Table shows that the price elasticities take negative signs in the short-run in the cases of the aggregate and its per capita, and the residential sector; both cases include the models which utilize non-oil GDP. In addition, it takes the negative sign in the case of the per capita residential consumption in the model which excludes the oil component from the GDP. The negative sign, in fact, agrees with economic theory in the sense that it would be expected to have a decline in consumption as a consequence of price increases. All the other price elasticities, however, take a positive sign; i.e., the wrong sign.

With regard to their significance, all the elasticities of price are statistically insignificant in all the estimated models. Therefore, due to the insignificance of all the estimated price elasticities, we attempted to delete the price variable from the model then re-estimated them. The results and their interpretations will be given later in this chapter.

ii) Income elasticities:

In terms of the signs, the income elasticities in the cases of agriculture in the two forms of GDP, and the residential sector (aggregate and its per capita) only on utilizing total GDP, take the correct sign (i.e., positive). In addition, the income elasticity of industry also takes the positive sign in the case of using non-oil GDP in estimation, while the rest of the income elasticities take a negative sign.

As for their significance, all the income elasticities are insignificant except in the case of per capita aggregate consumption - that is, using total GDP - despite having an incorrect sign.

In addition to the estimates of price and income elasticities, Table (1.18) also indicates that time plays some role in the adjustment of oil consumption in relation to changes in price and income.

4.4.2. Estimation after deletion of price:

As mentioned earlier, we have re-estimated the equations after deleting the price term from all the regression cases. Deleting the price term is due to its insignificance in estimation of the original models. Table (1.19) presents the income elasticities in both the short- and long-run. For comparative purposes, the price and income elasticities of the original estimation equations are also included in this table. From the table, it is clear that all the income elasticities are still insignificant.

To conclude the section on price and income elasticities of electricity demand in Egypt, it is clear that regression analysis has shown that both the price and income elasticities are small and insignificant in the short-run. The same conclusion could be drawn with regard to income elasticities even after deleting the price variable from the models.

5. Economic efficiency of energy: special reference to electricity:

In this part of the chapter, we will discuss the economic efficiency of energy supply in the context of developing countries in general. With respect to energy supply [41], it is considered efficient when the structure of energy investments brings about a cost-optimal mix of energy resources. This mix is achieved when energy is produced and delivered at minimum cost for given levels of reliability. However, energy end use becomes efficient when energy is consumed at minimum unit rates for given quantities and standards of consumption output. Nonetheless, the implementation of those two concepts of efficiency can mean a more relaxed position for developing countries to improve with respect to energy efficiency.

In fact, a developing country can opt for an improved energy efficiency through ([41], p 12]:

1) a reduction in its energy intensity;
2) separating energy demand from economic growth;
3) implementing supply-side policies; and
4) making the largest industrial consumers more energy efficient.

In the following, we will discuss each of the above points in some detail and at the end of this section, a very brief summary of the arguments will be given.

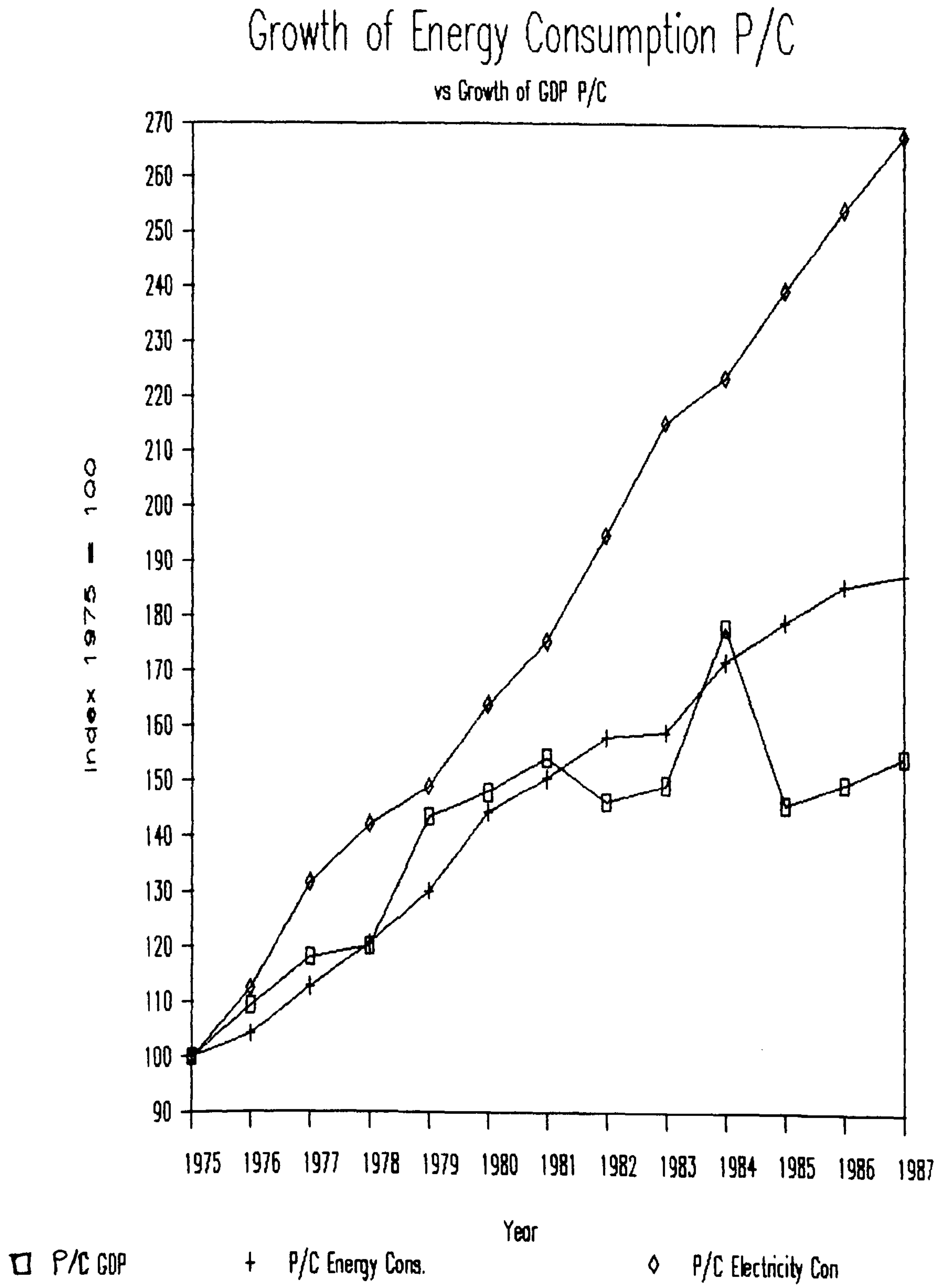
1) With regard to energy intensity, we were able to show in section 3.3 that most developing countries exhibit an increasing trend in their energy intensities in contrast to the falling trend in those of the developed countries. In fact, energy intensities of the developed countries have fallen sharply since the 1970's [41]. Industrialization in the developing world can be regarded as the main cause for the increase in their energy intensities. The experience of Egypt during the 1960's shows that the industrialization process has in fact engendered smokestack industries (such as Iron & Steel, Aluminium, etc...), a massive programme of rural electrification, urbanization and modernization; the end result being higher energy intensity. Figure (1.3) exhibits this increasing trend in energy and electricity intensities in Egypt since 1975. However, the Figure shows a steeper increase in the electricity intensity which is caused by very high rates of industrial consumption. Nevertheless, the increased trend in energy intensity was reinforced by minimal (if not nil) implementation of efficiency measures.

2. Due to the fast rates at which developed countries were able to implement efficiency measures, energy consumption and economic growth were decoupled. However, we have to point out that those countries were able to lower their energy intensities very rapidly by instigating efficiency measures at a time when absolute levels of energy consumption were relatively high for their stage of industrialization, and the

pattern of economic growth favoured less energy-intensive industries [41]. In fact, this has resulted in continued economic growth, mainly from service industries, and a reduction in the energy intensities of developed countries. This was evident during the 1970's especially in the aftermath of the first oil shock of 1973.

On the other hand, developing countries were unable to separate energy consumption from economic growth because of the different structural processes embodied within their price and income elasticities of energy demand. That is, their income elasticities of energy demand are higher than those of the developed countries and thus, there will be a tendency for consumers to consume more energy as incomes rise in accordance with growth of the economy. Price elasticities of demand for energy, however, are lower than those of the developed countries which implies that consumers will be less inclined to reduce their energy consumption in response to increases in energy prices [41]. In fact, Figure (1.8) indicates that the growth in the per capita energy (as well as electricity) consumption has grown alongside that of the per capita GDP since the mid 1970's. More importantly, the Figure indicates that the growth in both the per capita energy and electricity consumption has outstripped that of the per capita GDP. This is typically a characteristic of a developing country in the early stages of industrialization though it also detects an inefficiency in energy use.

Figure (1.8)


Growth of Energy Consumption P/C
vs Growth of GDP P/C
Index 1975 = 100
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
Year
P/C GDP
P/C Energy Cons.
P/C Electricity Con

3. The use of supply-side policies can have more rapid improvements in energy efficiency. However, the main objective of energy supply decisions is to secure high quality energy supplies at the lowest possible investment and operating cost to the economy, and to price these energy supplies to the consumers at their opportunity costs [41]. Therefore, developing countries have to strengthen efficiency in three main fields: i) investment planning, ii) operational procedures, and iii) pricing. In the following discussion, we will only deal with supply-side policies in those three areas within the electric power sector in Egypt.

i) With respect to investment inefficiencies, the electricity sector which can absorb up to two-thirds of energy investments, usually entails this type of inefficiency. It manifests itself in the form of excess generating capacity. In fact, the generation capacity in Egypt was significantly in excess of maximum demand during the early 1970's [Table (1.13)], though the reserve margins have declined over the last decade as the installed capacity did not expand hand in hand with maximum demand. The excess power generating capacity represents an unnecessary cost of investment capital which could be redirected productively to other sectors of the economy. In fact, reserve margins should only allow for the derating of electric power plants due to age, hydrology and operating conditions which usually cover maintenance, outage and breakdowns.

ii) Operational inefficiencies in the electricity industry are mostly observed in the transmission and distribution functions which include both technical (transmission) losses and un-metered consumption. Table (1.20) indicates that the transmission loss of the electric power sector in Egypt was 15% - 19% from the mid 1970's to date. A reduction in transmission losses results in savings of investment capital that would have been used inefficiently otherwise. In addition to transmission and distribution inefficiencies, operational inefficiencies can be also identified in the poor management of spare parts inventories [41]. In fact, Egypt experiences a great deal of power outages despite the fact that it has excess generating capacity. The usual scapegoat is the lack of foreign currency needed to purchase the spare parts, while the real reason being the bureaucracy and mismanagement of spare parts inventories. These disruptions of electric power do not serve to ration supplies as much as they impose unwarranted costs on various efficient economic activities.

iii) Inefficient pricing of electricity means that prices are not set equal to marginal cost;[13] i.e., they do not reflect the scarcity value of electricity or their true opportunity costs. In Egypt, electricity tariffs are set below marginal costs and in some instances have fallen in

[13] Chapter 2 is devoted entirely to marginal cost pricing in the electric power sector.

Table (1.20)

Transmission Efficiency of Electricity
Supply in Egypt
1974 - 1988/89

Year	Total Consumption (GWH)	Total Generation (GWH)	Trans. Effic. (%)	Trans. Loss (%)
1974	6895	8519	80.9%	19.1%
1975	8308	9799	84.8%	15.2%
1976	9662	11646	83.0%	17.0%
1977	11489	13526	84.9%	15.1%
1978	12723	15013	84.7%	15.3%
1979	13700	16216	84.5%	15.5%
1980/81	15591	18316	85.1%	14.9%
1981/82	17166	20623	83.2%	16.8%
1982/83	19637	23353	84.1%	15.9%
1983/84	22331	25889	86.3%	13.7%
1984/85	23762	29049	81.8%	18.2%
1985/86	26163	31458	83.2%	16.8%
1986/87	28511	33464	85.2%	14.8%
1987/88	30545	36895	82.8%	17.2%
1988/89	31690	38100	83.2%	16.8%

NOTE: Transmission efficiency is calculated as:
Total electricity consumption / total electricity generated

SOURCE: EEA Annual Reports of Electricity Statistics [25] real terms, i.e., have not been adjusted for inflation. The underlying reason for this inefficient pricing is to achieve social goals for the populace, relevant to the household sector. Other objectives sought range from political stability to government subsidy and protection especially in some inefficient industries. However, this kind of low level power tariffs represents a huge subsidy burden[14] on the Egyptian economy. Moreover, low level of power tariffs lead inevitably to a wasteful consumption patterns as consumers receive wrong signals through the inefficient pricing of electricity. This ultimately results in poor investment decisions being made by both the consumers and the government. In fact, poor investment decisions may lead to a further complication of allocating additional investment capital and foreign currency - both already scarce - by the government in order to cater for the upsurge in domestic electricity consumption.

Table (1.21) summarizes the arguments relating to the inefficiencies existing in energy supply. However, we ought to point out that in our above discussion, we only referred to those inefficiencies embodied within a typical electric power sector in a developing country where some examples from Egypt were also cited. Therefore, Table (1.21) only summarizes our previous arguments which are very specific to the electricity industry while there are other inefficiencies

[14]More details on subsidies in the electric power sector of Egypt are given in chapter 3.

TABLE (1.21)

SUMMARY OF INEFFICIENCIES IN ENERGY SUPPLY

INEFFICIENCY	MANIFESTATION	IMPACT
1) INVESTMENT	Excess generating capacity	Premature use of scarce capital and foreign currency
2) OPERATIONAL	i) Transmission and distribution losses ii) Mis-management of spare part invent-ories	i) Loss of income and investment, and, ii) Power outages and related economic costs
3) PRICING	Very low tariff (i.e., below marginal cost)	i) Wasteful consumption pattern ii) Poor investment decisions, and, iii) Huge subsidy bill burdened by the government

SOURCE: SUMMARIZED FROM SECTION 5.

in energy supply not mentioned in this section.

4. End use efficiency could be improved by encouraging the large consumers of energy to employ better housekeeping measures and make longer term retrofitting and process modifications to their industrial plants [41]. In fact, few industrial consumers account for a major share of the total energy consumed in developing countries and thus, various policy actions of end use efficiency and conservation methods can be directed towards a limited number of industries though with a much larger payoff potential. In section 4.2, it was stated that two industrial plants were responsible for consuming a large share of the total electricity used in Egypt. However, it seems very unlikely that implementing retrofitting and process modifications would not have significant improvements in end use efficiency. In fact, the technology embodied in some of those industries is highly energy-intensive and therefore a more radical modification in the technology to become less energy-intensive, is more practical in the long-run though quite expensive in the short-run. Secondly, most of the large industrial consumers of energy in Egypt are owned and regulated by the government which provides them with unlimited supplies of energy at extremely subsidized prices. This has in fact led to the emergence of economically inefficient type of industries that were able to survive only through government protection and hence the elimination of any domestic or foreign competition.

Therefore, fostering an open and competitive economy seems the best solution to achieve efficiency in energy supply and use as within the environment of an overall economic efficiency.

To summarize, a developing country can strengthen energy efficiency by reducing their energy (1) intensity in addition to (2) separating energy consumption from economic growth. However, due to industrialization - especially in early stages - and structural processes, it is quite unlikely that developing countries will be able to achieve either tasks easily nor quickly. Nonetheless, the introduction of improvements in (4) housekeeping and retrofitting, and conservation measures, can make the largest industrial consumers of energy - who are usually few - more efficient with respect to energy use. However, this entails process modifications which in many x instances may require a new less energy-intensive technology. On the other hand, a developing country can make immediate ?? improvements in energy efficiency by using supply-side (3) policies in order to strengthen investments, operational practices, and pricing decisions. In fact, we were able to show that this is very relevant for the electricity industry Where ? although we believe that the key to curtailing wasteful consumption, and hence increasing efficiency, is through enforcing a correct pricing structure for electricity.

5. Summary and Conclusions:

In the latter part of the 1970's, the introduction of the open-door economic policy of trade liberalization and private sector incentives has considerable impact on the growth of the Egyptian economy. However, a commendable increase in the national GDP was occasioned by the expansion in oil exports which was coupled with the massive upsurge in the international oil prices. Nonetheless, this was not a self-sustaining growth activity per se, and we were able to show that as soon as oil prices fell sharply, the Egyptian economy experienced a period of sluggish growth rates. In fact, the reason for the inability of growth to be sustained into the future was the mis-allocation of the resources made available by the oil sector to investment opportunities which would have contributed to sustained growth by using the other resources of Egypt - mainly and most importantly, labour.

Energy consumption in general, has been increasing very dramatically in Egypt over the last decade. Most of the demand for oil and natural gas originates in the electric power sector which consumes around a third of the total demand for oil in Egypt. Therefore, we are deemed to believe that controlling the growth of the electricity sector is the key to controlling the growth of the demand for oil and natural gas in Egypt. Such an objective could be achieved through pricing electricity on the basis of sound economic efficiency principles.

Moreover, both the energy and electricity intensities of Egypt has increased considerably since the mid 1970's, implying a wasteful consumption pattern which needs to be rationalized. In fact, electricity consumption has also shown massive increases since the mid 1970's. The unrealistic power tariffs are responsible for the huge demand. Not only do low electricity prices lead to a massive subsidy bill to be shouldered by the Egyptian government, increased demand for electricity - to say the least on wasteful consumption - exerts an added pressure on the depletable oil and natural gas resources in Egypt. In addition, low electricity prices result in sending out wrong market signals to be received by both parties concerned; i.e., the government as well as the consumers of electricity. The end result is poor investment decisions which entail a great deal of scarce investment capital and foreign currency that other sectors of the Egyptian economy can use more efficiently.

Finally, if Egypt is to pursue a policy of improved electricity - or indeed energy - efficiency, it has to employ mostly supply-side policies in order to strengthen investments and operational practices. Most importantly, however, the pricing structure of electricity has to be reformed so as to set electricity prices at their marginal costs. Not only would correct pricing result in an effective demand management, but also provides the electricity sector in Egypt with the cash flow required to finance their maintenance and expansion plans. Nonetheless, less electricity-intensive industries are needed to substitute those highly intensive ones which though may only be very few, they represent a major share in total electricity consumption in Egypt. In spite that this process could be very costly in the short-run, the benefits it accrues in the long-run will out-weigh the initial costs incurred. Lastly, the Egyptian government has to opt for an open and competitive economy in order to remove all distortions present, to achieve overall economic efficiency and indeed an efficiency in electricity supply and use.

APPENDIX A1

TABLES (A1.1) & (A1.2)

TABLE (A1.1)

TOTAL & PER CAPITA REAL GDP
AND NON-OIL REAL GDP IN EGYPT
1976 - 1986/87
(AT CONSTANT 1975 PRICES)

YEAR	POPULATION	GDP	P/C GDP	NON-OIL GDP	P/C NON-OIL GDP
	MILLIONS	M.L.E.	L.E.	M.L.E.	L.E.
1976	38.2	5714	150	5485	144
1977	38.8	6275	162	5878	151
1978	39.8	6543	164	6080	153
1979	40.9	8040	197	6752	165
1980/81	43.3	8560	198	7143	165
1981/82	44.5	9179	206	7928	178
1982/83	45.8	8951	195	8028	175
1983/84	47.2	9379	199	8208	174
1984/85	48.5	11519	238	9684	200
1985/86	49.9	9709	195	9266	186
1986/87	51.3	10180	198	9746	190

SOURCE:
DATA ON GDP AND POPULATION AS WELL AS WHOLESALE PRICE INDEX (USED AS DEFLATORS) ARE OBTAINED FROM CAPMAS STATISTICAL YEARBOOK [12], SEVERAL ISSUES

TABLE (A1.2)

AGGREGATE & SECTORAL ELECTRICITY CONSUMPTION
AND (AVERAGE) PRICES IN EGYPT
1976 - 1986/87
(AT CONSTANT 1975 PRICES)
(MILLION KWH & MILLS/KWH)

YEAR	POPULATION (MILLIONS)	AGGREGATE			INDUSTRY		AGRICULTURE		RESIDENTIAL		
		TOTAL MKWH	P/C KWH	PRICE M/KWH	CONS MKWH	PRICE M/KWH	CONS MKWH	PRICE M/KWH	TOTAL MKWH	P/C KWH	PRICE M/KWH
1976	38.2	9662	253	8.0	5847	7.3	671	7.3	1374	36	14.1
1977	38.8	11489	296	6.8	7180	5.8	698	6.7	1685	43	12.8
1978	39.8	12723	320	6.4	7553	5.7	697	5.9	2197	55	11.3
1979	40.9	13700	335	5.0	7800	5.3	720	5.3	2670	65	9.0
1980/81	43.3	15591	360	4.2	9186	4.9	777	5.9	3583	83	9.1
1981/82	44.5	17166	386	3.8	9593	5.1	836	6.3	4373	98	9.5
1982/83	45.8	19637	429	3.6	10270	5.0	942	5.7	5484	120	9.6
1983/84	47.2	22331	473	3.4	11494	4.7	1048	6.3	6816	144	8.8
1984/85	48.5	23762	490	3.6	11758	5.2	1108	5.6	7762	160	8.6
1985/86	49.9	26163	524	3.6	12758	7.0	1197	7.4	8850	177	9.4
1986/87	51.3	28511	556	4.3	13894	5.5	1166	6.9	9755	190	7.4

SOURCES:
1) NOMINAL PRICES FOR SECTORAL CONSUMPTION 1976 - 1981/82 ARE OBTAINED FROM EEA [28]
2) NOMINAL PRICES FOR SECTORAL CONSUMPTION 1982/83 - 1986/87 ARE BASED ON OWN CALCULATIONS PRESENTED IN CHAPTER 3, TABLE (3.13)
3) AVERAGE PRICES FOR AGGREGATE ELECTRICITY CONSUMPTION IS OBTAINED FROM EEA [28]
4) DATA FOR ELECTRICITY CONSUMPTION ARE FROM EEA [25]
5) POPULATION DATA FROM CAPMAS [12]
6) DEFLATORS FROM CAPMAS [12]

CHAPTER TWO

ELECTRICITY PRICING IN DEVELOPING COUNTRIES: ISSUES AND POLICIES

1. Introduction:

In its simplest form, the price of a good is what it costs a consumer to obtain an additional unit of the good, while the marginal cost is a measure of the value of the additional resources required to produce it. Throughout the economics literature, the relationship between price and marginal cost has been extensively analysed. It is intuitively clear, however, that there is a general agreement between economists to set the price equal to marginal cost. That is, setting the prices of all goods and services equal to marginal cost is believed to be a means of achieving an optimal level of the general welfare. Hotelling [39] asserts that if a firm attempts to sell its industrial products at prices high enough to cover marginal costs and all other fixed costs (i.e., at a price above marginal cost), an inconsistency with the social efficiency takes place. In the context of public utility pricing, Hotelling argues that if a government charges for electricity a price sufficiently high to repay the investments incurred, the benefits will thus be reduced to an extent far exceeding the revenue sought by the government.

Although the general consensus among economists is to set price equal to marginal cost, the measure of marginal cost itself is different whether it is measured for a short or long period of time. In fact, there is a great deal of controversy over the issue of public utility pricing at short-run marginal cost (SRMC) as opposed to long-run marginal cost (LRMC). This controversy is exhibited in the considerable literature in which economists have debated both the advantages and disadvantages of setting the prices equal to either the short- or long-run marginal costs.

This chapter will be primarily concerned with outlining the economic principles of electricity pricing within the context of a developing country. In the attempt to do so, however, one has to highlight some of the main arguments in this area. Hence, the next section will briefly review some of the arguments which dominated public utility pricing with an application to the electricity field. The issue of equivalence between the two types of marginal costs will be touched upon. However, the same section will attempt to outline the main ideas embodied in efficiency pricing of electricity whereby the problem of capital indivisibility will be analysed and solutions to accommodate it will also be presented. In addition, the advantages and disadvantages of pricing at either SRMC or LRMC will be discussed where we will tend to adopt one specific view. Section three will be devoted to developing a methodology for electricity pricing based on basic economic principles as well as recent experiences of developing countries. We will show that there are other objectives beside economic efficiency which the electricity utility ought to take into consideration. Thus, we will outline the different stages inherent in the calculation of the LRMC tariffs. We will also try to deal with the second-best problem frequently encountered in the distorted economies of most developing countries. In addition, section three will touch very briefly on the issue of equity in electricity pricing, while it will be discussed in chapter 3 in some detail. In section five, a review of the major studies conducted on the electricity supply industry in Egypt. We discuss some of the studies and present the results of their calculations of marginal costs. In the sixth and final section, we summarize the chapter and make few concluding remarks.

2. SRMC and LRMC pricing, a review:

2.1. Natural monopoly and marginal cost pricing:

In general, the authorities worldwide recognize only one electricity distributor for a geographically homogenous zone and give it the right to perform its activities within a legal framework defining its duties: the point then is to define the "public service" activity of an electricity distributor. However, the profits linked to the uniqueness of a distributor are obvious, so is the risk of development of monopolistic practices. Thus the customer may fear that the monopoly distributor may use forms of "dumping" on some markets, and ransom others. Consequently, rules must specify the objectives of the monopoly and the way prices will be fixed for the different services offered. Economic theory can guide the choice of these rules.

As regards production, theory shows clearly that for the achievement of a collective optimum, the producer must meet demand and minimize production cost in the broadest sense of the word, i.e., including standard of service. However, the real problem lies in the necessary coordination between the utility's and customers' decisions. The customer makes his choice in terms of his own interests, i.e., according to the tariffs presented to him. This is how he decides among the options open to him. It is then the utility's duty to inform him on the economic consequences of each of his decisions on the community. To this end, economic theory suggests a solution: selling at marginal cost. The aim of marginal cost pricing is to provide price signals whereby customers would be enticed to use their electrical equipment in the general interest.

2.2. Development of literature:

Early writings on public utility pricing prior to World War II appear to have advocated pricing according to SRMC[1]. In the post-war discussion, however, two major schools have made a departure from the generally accepted principles of public utility pricing which prevailed at that time. These two schools, namely the French and British, have re-

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[1]A comprehensive review of the literature is found in N. Ruggles, "Recent developments in the theory of marginal cost pricing", Review of Economic Studies, 1949, [70].

established the principle of equivalence between SRMC and LRMC and furthermore, recommended pricing according to LRMC.

Historically, as the wave of nationalization of public utilities in France reached its peak just after World War II, French economists as well as engineers showed a considerable interest in marginal cost pricing. In fact, a group of French authors had set out to establish pricing and investment rules for the nationalized public utilities in France which were directed mainly towards the achievement of social efficiency goals rather than profit maximization.

There is some confusion over the definition of marginal cost in itself. This confusion appears to have stemmed from the time horizon over which it is to be measured, i.e., whether marginal cost is applicable in the long-run or the short-run. Thus, before one embarks on reviewing some of the main arguments relevant to this issue which dominated the economics literature, it would be appropriate first to define both definitions of marginal cost, that is, the SRMC and the LRMC.

2.2.1. Short-Run Marginal Cost (SRMC):

The SRMC of a unit of supply is the additional generation, transmission and distribution cost which flows from it for unchanged production facilities. SRMC indicates the actual incremental cost to society incurred by the consumption or use of an additional unit of output or service provided that the capital stock is fixed and that the only way in which output can be increased is by changing the level of variable inputs. Thus, the SRMC would be clearly the cost of the additional variable inputs required to produce an extra unit of output. However, it has to be stated that if the electricity producer is unable to modify his generation, transmission or distribution capacity, or simply if he is operating at or above design capacity, then it may imply that he would be unable to meet total demand at certain peak periods. Thus, the definition of the SRMC - as we will show later in this section - has to be extended to include the concept of "failure cost" which reflects the cost to the community resulting from the electricity producer's inability to meet total demand with his available facility.

2.2.2. Long-Run Marginal Cost (LRMC):

The LRMC of a unit of supply is the additional generation, transmission and distribution cost which stems from it for a given year, assuming that the producer modifies his capacity. In practice, this modification of capacity is obtained by bringing forward an investment which would normally have been made the following year. The cost of this operation for a given item of equipment, referred to as its "forward cost"[2], is the sum of:

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[2]Also known as the anticipation cost of increasing the existing capacity by one additional unit.

- the "unit investment cost" multiplied by the discount rate.
- the depreciation of the first year, determined on an economic basis, i.e., as the change in the value of use during the year.
- the fixed operation and maintenance costs of this equipment in the first year.

2.3. Equality of SRMC & LRMC in an optimum system:

Boiteux' [9] main contribution to pricing and investment in electricity is the re-establishment of the equivalence between SRMC and LRMC alongside his recommendation that electricity pricing ought to be based upon LRMC. Boiteux proves that for optimum electricity plant, differential cost (SRMC) is equal to development cost (LRMC). In other words, a plant is of optimum capacity when differential cost pricing covers not only working expenses but also plant assessed at its development cost. Thus, by establishing the equivalence between SRMC and LRMC, Boiteux outlines an investment rule whereby plant development or expansion becomes acceptable only when 'the differential cost rate pays for this development' ([9], pp 70].

Turvey, ([80] & [81]) an eminent economist heading the British school, wrote extensively in the 1960's and 1970's on optimal electricity pricing and supply. He accepted as well as advocated the equivalence between SRMC and LRMC established previously by other authors. Despite the acceptance of the equivalence, Turvey recognizes that such an equivalence is valid only given correct forecasts of demand and also when capacity can be optimally adjusted through time. According to him, electricity prices have to be set equal to LRMC even if the above conditions of equivalence were not met. Lack of information about consumer reaction and the need for price stability, argues Turvey, make pricing based on LRMC preferable to SRMC.

For an optimal mix of plants and an optimal transmission and distribution network, SRMC and LRMC are equal. This very general statement is characteristic of an optimum generation, transmission and distribution system, providing that the indivisibilities can be neglected.

The equality can be understood as:

- if SRMC > LRMC, then it is in the producer's interest to develop his system since he will meet demand while decreasing total cost.
- if, by contrast, SRMC < LRMC, then the producer can meet demand at a lower cost by forbearing from making some investments.
- finally, if there is equality, then the producer will not be able to lower the cost by modifying his system. That is, demand is being met at the lowest cost; it is optimal.

2.3.1. Conditions of optimality:

If at any time, generation capacity is sufficient (i.e., maximum available capacity has not been reached) then the cost incurred by an additional demand of one KW is simply the proportional fuel cost of the marginal unit (additional unit) which is basically the most expensive unit, given that plants are operated in order of merit; i.e., in an increasing order of fuel costs. This is due to the fact that the additional unit implies the use of the plants with the highest fuel cost, which are only partially in operation or not running at all when the additional demand occurs.

However, whenever there is a tendency for electricity demand to increase, an increase in capacity would be required in order to maintain a given standard of reliability during such periods of additional demand. Nonetheless, there may be a situation of shortage occurring whereby the system would be unable to supply demand under normal conditions of operation.[3] That is, the producer would be unable to modify his generation, transmission or distribution capacity which is necessary to meet the extra demand. In such cases, the producer may have to use some exceptional means such as having a drop in voltage or even this could entail cutting of the supply to another customer.

Within this context, any investment planning of the

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[3]That is, with the possibility of random variations in demand or random outages considered.

electricity system has to take into consideration this element of risk in such a way that an acceptable level of risk would be agreed upon. Inherent in this notion of risk is the concept of "shortage cost" which reflects the cost to society resulting from the electricity producer's inability to meet demand with the existing capacity. In simple terms, if each KWH not supplied is assigned a shortage cost, then it could be argued that the system's capacity would be increased until the cost of additional capacity is equal to the reduction in the total annual costs which result from the savings in fuel and operation costs[4] as well as the reduction of the shortage cost. In other words, an optimal least cost development plan would require that the economic balance of the addition of one KW of a given type of equipment is nil, i.e.,

investment cost	+	discounted fixed operation & maint. costs	=	discounted saving in shortage	+	discounted fuel saving

The left hand-side of the equality is known as the anticipation cost, while the right hand-side is the savings cost.

Galland et al [35] and Abou Neima [4] have derived the mathematical form of the above equality.

The issue of equivalence between SRMC and LRMC derived by Boiteux and accepted by Turvey and others, was critically reviewed by some economists mainly with regard to the

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[4] The savings in fuel and operation costs are brought about through the installation of new more efficient units.

assumptions under which the equivalence were derived. Boiteux in proving the equivalence, assumed that capacity can be continuously changed. It has been argued by Andersson and Bohman [5], in fact, that such an assumption bears no relation to reality where the general case in electricity generating plants is that their capacity is not continuously variable. Once an electricity plant is built, capacity can neither be varied continuously nor rapidly. In other words, there is a considerable indivisibility which may persist for some time.

Andersson and Bohman [5] are convinced that Turvey has advocated the equivalence between SRMC and LRMC under very restrictive assumptions. Moreover, Kay [43] agrees to such a criticism whereby he argues that the relationship between the long-run concept and LRMC was mis-stated by Turvey.

2.4. Efficiency pricing of electricity:

From the standpoint of economic theory, economic efficiency is maximized when price is set equal to SRMC at each moment in time. SRMC indicates the actual incremental cost to society incurred by the consumption or use of an additional unit of output or service. Strictly interpreted, the marginalist approach requires that price should equal SRMC when capacity is less than fully utilized, but if demand increases so that existing capacity becomes fully utilized, price should be raised to ration existing capacity. However, this enforced equilibrium also eliminates any market signal that new investments are needed, unless SRMC has risen to such a level that they actually can cover the instantaneous costs of such investments.

In fact, such pricing is correct from the viewpoint of economic efficiency because prices that reflect marginal costs are equal to the net opportunity costs of resources at the margin needed to bring forth the additional supply. Therefore, in order to achieve the greatest overall social efficiency, consumption decisions ought to be based on SRMC.

However, the strict application of such prices is appropriate - or feasible - only in a static world in which there is no change, i.e., in which demand remains constant or declines, in which no lumpy investments is ever needed to increase capacity or to replace worn-out equipment. One important aspect for SRMC pricing that is generally overlooked is that in cases of capacity shortages, SRMC become really discontinuous. What this means is that even substantial increases in prices will not bring forth new supplies. All that these higher prices can do is choke off part of the existing demand until equilibrium is reached between willingness to pay (i.e., demand) and available supply. Thus, it is appropriate to discuss this particular problem in some detail.

2.4.1. Marginal cost and capital indivisibility:

The foregoing discussion mentioned a particular difficulty encountered in pricing which is usually apparent in the presence of capital indivisibility, a condition typical of electricity supply where productive capacity is often installed to make up for deficits in current supply and to meet future demands for a number of years hence. Initial costs of constructing hydro- or even thermal- generating units are usually very high in relation to fuel costs and operating and maintenance costs. Since the costs of such investments prior to their irrecoverable commitment are variable, they have to be included in the calculation of overall marginal costs. However, as soon as they have been made they become "sunk" costs so that they no longer affect decisions at the margin. As a consequence, marginal costs again fall to the incremental level of operating (i.e., variable) costs, and investment costs once again are ignored. Price therefore plays the roles of (a) obtaining efficient utilization of resources when operating at less than full capacity, and (b) providing a signal to invest in additional system capacity.

Nonetheless, the amplitude of these price fluctuations resulting from such "before" and "after" considerations in typical developing country electricity supply systems would be huge, if the costs of the additional, required capital investments were to be charged to consumers at the time new investments have to be made. Price fluctuations of such magnitude would be unacceptable for any economy. They would certainly be highly disruptive to any electricity-cost-sensitive activity such as cement, aluminium, or steel production, or fertilizers. They would also be unacceptable to domestic consumers would be a source of considerable uncertainty for consumers and which would create problems for planning long-term investment in facilities complementary to, or competitive with, electricity consumption. Even in cases where it is technologically possible to extend capacity in fairly small increments, fluctuations in the availability of finance may mean that capacity is extended in large lumps. This issue is particularly important in LDC's, where large backlogs in supply may be remedied and excess capacity created at the same time. Economic as well as political considerations would rule out the adoption of such pricing patterns.

2.4.2. Solutions to capital indivisibility:

As a solution to this difficulty, two alternative approaches are usually offered in order to maintain reasonable long-term price stability while aiming at the equivalence of willingness to pay and incremental cost of supply at the margin. The first alternative is to utilize a two-part tariff, which would consist of a fixed periodic charge[5] reflecting capital costs and the other part reflecting the SRMC of the electricity supplied. Such tariffs have been particularly recommended for situations in which peak-load capacities are needed.

However, one has to point-out that there are some problems encountered in applying this particular type of tariff. The main problem arises due to the notion that a potential electricity user would either have to pay the fixed charges, or do entirely without electricity. Once he pays, the fixed charges no longer affect his consumption pattern. In this case, only the variable unit costs (i.e., fuel, operating and maintenance costs) are relevant to his decisions whereby if they are low relative to capital costs, wasteful consumption is the most likely outcome. This waste, in turn, would result in higher growth rates, which would require larger and more frequent additions to capacity. But capacity costs, once again, would not affect electricity use, creating a vicious cycle of rapidly rising, economically unjustified electricity-use patterns. In addition, such tariffs would tend to exclude the poor since they could not afford to pay the high fixed charges. To conclude, applying a two-part tariff to finance all capital costs may be economically inefficient in managing electricity supply except in cases in which the SRMCs are a substantial proportion of the LRMCs.

The other alternative for dealing with indivisibilities

[5]Or one-time connecting charge.

would be to utilize a forward-looking averaging approach. The costs of the marginal investment costs (i.e., the costs of forthcoming investments) would be spread over an appropriate period.[6] These leveled-out capital costs, annuitized at the appropriate rate of interest, would be divided by the electricity units supplied (i.e., KWH) per year and added to the marginal operating costs. The total unit charge would then reflect LRMCs in contrast to the SRMCs. Including this annuitized capital cost charge in the marginal cost price structure actually is a vitally important signal to an electricity consumer of the real costs of his consumption. With growing demand, each additional unit consumed encroaches upon existing capacity and raises the specter of additional future investment costs. The levelized capital costs and charges, therefore, are nothing but a measure of these future costs. In fact, the average incremental cost estimate (AIC) definition gives marginal cost estimates which smooth out lumps in expenditure streams while at the same time reflecting the general level and future costs which will have to be incurred as electricity consumption increases. Where unit costs are lumpy, the AIC estimate will always be above SRMC and will therefore tend to discourage "justified" consumption when there is excess capacity and to provide premature investment justification signals as capacity reaches full utilization. In this sense, the (AIC)

[6]In most cases, the period corresponds to the life expectancy of the asset while it is sometimes the financing period of the electricity utility.

represents a definition of marginal cost in a way which attempts to: (a) compromise between short-run allocative efficiency goals and the need to signal the justification of investment in additional capacity, and (b) look beyond the traditional economic definition of the long-run by including all future investment costs during a specific time period; usually 10 to 15 years would be the maximum period for which reliable data would be available.

In looking beyond the next increment in capacity, the AIC makes different assumptions about the proportion of the investment which must be paid at one point in time in order to reveal consumer willingness to pay, and about the relevant magnitude of the next increment in capacity, which is invariably difficult to specify, particularly in large and complex systems in which many investments (some of which produce joint products) are taking place simultaneously.

2.4.3. Marginal costs and temporal variations in costs:

Electricity differs from other goods by the great variability of its demand over time and the quasi-impossibility of storing it. In fact, the basic theory of marginal cost pricing of a single good can be easily extended to the case in which the utility produces several goods: in the case of electricity, KWH at different times of the day and sometimes, at different seasons of the year. Thus, each good (in this situation, KWH) must be sold at a price reflecting its marginal cost when supply and demand are in balance. In addition, the marginal cost pricing principle implies that price should reflect variations in the cost of supplying electricity to different consumers.

It may therefore be desirable to distinguish between consumption at different times and at different locations. In the case of electricity supply, the cost of consumption varies by time of day and in some cases[7] by season. Therefore, whether pressure on capacity is due to demand peaks or supply troughs or both, there is a strong case for varying the price of electricity in order to achieve an efficient allocation of supplies. Theoretically, unless capacity is fully utilized during the off-peak period as well as during the peak, the rule should be that off-peak users pay just for SRMC (operating costs) while peak users pay for all marginal capacity costs plus the marginal operating costs incurred during the period. Consequently, as a result of a revealed willingness of consumers to pay the extra amount for electricity during peak periods, the electric utility has to accommodate for peak demand by constructing reservoirs in hydro projects or by expanding capacity (i.e., peak generating units to operate only during peak demand) - or even both in some cases.

There are, in fact, many variations on a common theme.

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[7]In the case of dry season (wet season) in hydro-generating units.

The simplest to deal with peak-load pricing is a two-part tariff where an electricity consumer would pay an amount per KWH consumed equal to marginal cost, plus a lump sum (large fixed charge) covering non-marginal "sunk costs" as well as consumer-related costs. In this way, as long as liability to the lump sum payment does not deter anyone from consuming the system's electricity altogether, optimal allocation may be achieved. That is, those consumers of electricity who infringe on capacity will have to pay for the incremental cost of capacity (marginal capacity cost) in addition to the variable operating costs (i.e., SRMCs, while those who adjust their consumption to low system costs, that is, during off-peak periods, will only have to pay for the latter costs. In brief, peak electricity users will have to bear the full burden of their expensive consumption by paying for capacity expansion.

2.5. SRMC or LRMC, pros and cons:

Marginal cost pricing, as applied to electricity supply, is a viable means of achieving efficient resource allocation, in the sense of ensuring that the benefits of expenditures in the sector exceeds the costs. If price is set equal to marginal cost, and consumers demonstrate their willingness to pay such a price, it means that they place a value on the marginal unit consumed at least as great as the cost to the rest of society of producing that unit; output and consumption should therefore be expanded when system capacity is reached. If, on the other hand, the market clearing price is less than marginal cost, it can be assumed that there is oversupply: the cost of additional output exceeds the benefits.

To understand the essential difference between SRMC and LRMC, it is useful to review briefly their definition and meaning. Marginal costs are defined as the net change in total supply costs resulting from an incremental change in output. This means that in the short-run only variable costs (i.e., the costs of those inputs which vary with changes in output) form part of the marginal cost accounting framework. Because the fixed costs of existing plant (e.g., capital equipment, buildings) remain constant, they are netted out and ignored in the determination of marginal costs.

Therefore, the efficient price of electricity is the SRMC of producing the electricity, but, if production cannot be increased, it is the price at which demand is equated to the given supply. It is argued that when the two marginal costs differ, the LRMC is not the price. There is a long history of confusion on this point, mostly arising out of a failure to distinguish various aspects of the problem of optimising electricity supply. Several points, however, can be made fairly briefly. First, the SRMC is well defined by the existing stock of equipment and options open in the short run (and, indeed, is typically carefully calculated in determining the merit order of power stations). The LRMC is not as well defined, since it is a forward-looking concept based on expectations as to the best choice of investment to expand the system. Second, if demand were constant throughout the year, and if investment were optimally undertaken with no indivisibilities, then the two marginal costs would be identical. Third, proponents of LRMC pricing concede the need for "promotional" pricing in the presence of excess capacity, and recognize the need to ration limited supply by raising prices in the face of excess demand.

On the other hand, the application of the SRMC approach has been severely criticised on the basis that there are problems encountered on attempting to apply it. For example, due to the lumpiness of investments in electricity facilities, prices based on SRMCs would vary frequently, and thus, would be impractical, confusing and expensive to implement. Furthermore, pricing at SRMC may not guarantee that revenues would cover total costs, i.e., would lead to loss-making. This means that modifications of the simple, SRMC pricing principle are needed. These modifications should meet three criteria: First, they should maintain the basic integrity and advantages of marginal cost pricing, aiming at the equivalence of willingness to pay for the incremental cost of supply at the margin. Second, they should assure that all supply related costs (incremental capacity costs) are borne by the respective customers. Third, they should maintain reasonable long-term price stability or price predictability to facilitate forward planning of energy-use related investments.

In fact, Newbery [59] and Heady [37] argue that the difficulties of SRMC pricing can be dealt with by offering contracts of varying length during which an agreed quantity of electricity is sold at an agreed stable price. Variations in consumption above or below this contracted amount would be priced at the spot price, or the SRMC. Consumers would then have a planning price for investment decisions and a decision price for short-run consumption decisions. They do not say, however, how this "stable price" for long-term contracts is to be calculated.

In the foregoing discussion, an attempt was made to review some of the main arguments for and against pricing electricity at either SRMC or LRMC. At this stage, however, one has to adopt a specific view. Only a naive economist would advocate a pricing approach based on either SRMC or LRMC without considering three main points:

a) the ability to compute either SRMC or LRMC relatively accurately;

b) the distortions resulting from a price set equal to incorrectly computed costs; and

c) the length of the period to which the tariff will relate [86].

The first two points appear to be in favour of pricing at LRMC. That is, SRMC as mentioned previously, varies frequently and therefore poses a considerable difficulty in measurement. At the same time, with the help of advanced forecasting techniques and more sophisticated computer software, the calculation of LRMC has become reasonably reliable. i.e., estimates of future capital, operation and maintenance and fuel costs in addition to projections of demand, interest rates, and inflation can be computed with a fair amount of accuracy.

The third point, however, seems to have been ignored by many economists in the literature concerning the application of either the SRMC or LRMC in electricity pricing. There are a number of arguments which suggest that marginal costs should be measured over a relatively long period and hence, that LRMC based tariffs should be used. First, frequent changes in the structure of tariffs are expensive to administer. Second, an electricity supply system, that is, electricity generation, transmission and distribution, usually requires large capital with long lead times and lifetimes. Once an investment decision in electricity is made, there is a lock-in effect with respect to supply. In effect, prices have to relate to the long-run planning horizon [56]. Thirdly, not only does it take time for electricity consumers to adjust to the changing tariff structures in the short-run, their investment decisions become distorted as well. That is, electricity consumers, in general, base their investment decisions partly on energy-using complementary products according to their own perceptions of future prices of the different forms of energy. Current electricity prices (or energy prices in general) act as price signals which should give adequate information regarding future prices of electricity. In brief, long-run prices are believed to be those required for efficient investment decisions. Fourthly and finally, in most cases, developing countries for obvious political reasons like maintaining price stability for staple-foods and energy over a relatively long period of time, thus, within the context of electricity prices, tariffs must be structured in a way so as to avoid unnecessary large price fluctuations which would result via the implementation of the SRMC approach.

Therefore, in the light of the discussion presented, we are led to the conclusion that adopting a pricing policy in electricity based on LRMC tariffs would not only satisfy the basic economic principles of pricing but also be flexible enough to meet (or at least attempt to accommodate) the conflicting objectives of the electricity sector and those of the economy in general. In fact, LRMC based tariffs permit a high degree of tariff structuring in addition to maintaining a fair amount of price stability over a relatively long period of time.

Moreover, in the case of Egypt, there is evidence suggesting that the use of LRMC based tariffs would be more feasible than those based on short-run ones. That is, the marginal operating costs have exceeded the costs of building new capacity, while the demand for electricity is large enough and growing at such a rate out-pacing available capacity. At such a consumption level and the fact that hydropower has reached its maximum capacity, expanding the existing generation capacity has been met through the building of new thermal plants, and therefore, the cost of capacity has to be included in the marginal cost of electricity supply in Egypt [88]. In other words, due to the fact that demand for electricity in Egypt is growing considerably and that the electricity utility is continuously expanding capacity (i.e., almost reaching full utilization), one has to recommend the adoption of the LRMC based tariffs in order to account for marginal capacity costs.

3. Electric power pricing in developing countries, an overview:

In the electric power industry, poor investment decisions such as an excess or shortfall of capacity, or sub-optimal plant mix, may take many years to recover from [70]. This is attributed to the long lead times either to build new plants to adjust to the required capacity or even for the demand to increase to the extent to justify new plant additions. A common feature of power system disequilibrium therefore arises in these countries particularly when tariffs are sufficiently low that the demand for electricity becomes significantly stimulated. In fact, low electricity tariffs can lead to the sector's inability to finance new investments due to the low revenues it generates. Not only are investment projects delayed because of the lack of finance, demand may grow faster than the sector's ability to implement capacity additions. Shortages in potential capacity can in turn lead to low capital cost, high fuel cost plant (gas turbines for instance) being installed instead of other lower cost plants (e.g., hydro-plants). Eventually, this aggravates the imbalance in the power system and promotes higher imports (or reduced exports) of fuel (petroleum). Furthermore, the utility's chronic problem of raising sufficient revenues to meet its financial requirements makes it more dependent on government support implying yet a further loss of efficiency. From a different perspective, the electric utility's poor financial performance may well lead to an inability to attract skilled and motivated technicians due to the low wages of the sector. Overall, one can observe that these tendencies reinforce each other in a downward spiral that eventually has its negative impacts on the government budget and the balance of payments; on the economy in general.

In fact, the needs for adjusting the nation's economy place a greater emphasis on achieving efficiency in the electricity sector [70]. Therefore, long before the decision to invest in electric power is made, there are certain broad issues that need to be tackled. These include the total energy needs in the future, the availability of supply, and the optimal mix of the different sources to be developed. In an ideal situation, the investment and pricing policies of a nation's energy sector, should be analyzed and determined within an explicit integrated framework [54].

Across all nations at present, there is an increasing demand for energy required for domestic, industrial, commercial, agricultural, and transport uses. However, this demand is constrained by the short-term depletable fossil fuel supplies as well as the longer-run renewable energy sources.

Therefore, within the context of an integrated framework, four basic decisions are needed for any energy policy. First, the appropriate level of demand for energy that must be satisfied to achieve social goals should be determined. Second, the optimal mix of energy sources that will meet the required demand must be established, based on several national objectives. Third, closely associated with and following the investment decision is the pricing policy, which will be based on certain criteria or objectives.

Finally, once the important decisions of energy policy have been made at the national level, the electric power sector must perform similar but a more detailed analysis at the sectoral dis-aggregated level.

3.1. Objectives of electricity tariffs:

Within the perspective of electricity pricing, the choice of a pricing policy will depend upon a number of objectives it pursues as well as the constraints imposed upon its supply capacity. Since these objectives have to be consistent with national objectives, there isn't one set of common objectives among countries to be pursued in a pricing policy. The discussion of pricing policies cannot proceed without the acknowledgement of three basic objectives sought by electricity tariffs; namely the efficiency, financial, and equity objectives. Furthermore, for a developing country, there may exist certain objectives in addition to the four above which have to be taken into consideration in setting electricity tariffs.

3.1.1. First objective:

This is related to the economic efficiency in the allocation of the country's resources between all their possible uses. In general, it is known that an allocation is efficient if it is impossible to reallocate resources so as to make some consumers better off without making others worse off. Although the electricity utility does not fix consumption of electricity, it aims to structure long-run tariffs so that consumers' decisions about consumption result in an efficient use of the country's resources [68]. Such a task could be achieved by using prices that reflect cost to indicate to the electricity consumers the true economic cost of supplying their specific needs, so that supply and demand can be matched efficiently. For the community, the principle of economic efficiency is consistent with the first principle since the cost a customer entails for the electrical system will be reflected in the tariff applied to him. As regards this cost which is indicated in the tariff, each customer takes decentralized decisions as to whether he maintains his demand or modifies it. Thus, economic efficiency is guaranteed, since no energy is produced if its cost is higher than that which the customer acknowledges, and vice versa. From a different perspective, if the marginal value of an increment of output is indicated by its price, and its marginal cost indicates the forgone opportunity of using resources elsewhere, then an output that equates price to marginal cost can be considered "ideal" in the sense of maximising net economic benefits. No other output would allow an increase in net consumer benefit, and therefore the resource allocation is efficient.

3.1.2. Second objective:

This objective is concerned with the achievement of the financial targets relating to the viability and autonomy of the electricity sector. In general, marginal cost pricing may not produce a desirable financial performance; significant surpluses or losses may accrue to the utility.[8] There is likely to be a financial surplus if prices were set equal to the strict LRMC. This financial surplus takes place because marginal costs of supply are

[8]SRMC pricing leads to financial losses, while LRMC pricing leads to surpluses.

higher than average costs when the unit costs are increasing. Such a surplus can either be taxed away by the government which is rarely applied or it can be alternatively used to finance the electricity sector's investment programme [56]. On the other hand, the surplus revenue can be used in a way that is consistent with other objectives. For instance, certain low-income groups of the society can be supplied with electricity at subsidized prices or at life-line rates to satisfy their basic requirement of electricity. Although the electricity sector's gross trading surpluses may be an important source of government revenue, electricity prices must accomplish two major financial objectives in this respect. The first is the financial viability of the electricity sector, while the second relates to the general revenue goals of the government. That is, not only do they have to raise sufficient revenues to satisfy a fair rate of return on assets (existing electricity plants), but to be able to self-finance an acceptable portion of the investments deemed necessary in the future as well. The financial objectives are often embodied in criteria such as target financial rates of return on revalued assets, or acceptable rates of contribution towards the costs of future investment programmes. In the case of England and Wales, the 1957 Electricity Act [67] requires the electricity utility's revenues to be at least sufficient to meet revenue costs taking one year with another (Section 13 of the 1957 Act). Nevertheless, the utility has to meet the financial targets set occasionally by the British government. The target originally set for the financial period 1980/81 - 1982/83 was 1.8% return on average net assets [67]. Providing sufficient revenue flows to electricity supply organizations, whether they are publicly or privately owned, is of major importance for maintaining efficient and reliable operations (although the meeting of financial targets is only a necessary but not a sufficient condition to meet this goal). Without sufficient revenues, day-to-day operations will suffer, maintenance will be neglected, plant and equipment will deteriorate, and capable staff will leave. The results are unreliable electricity supplies which are far more costly to an economy than high electricity prices. A surplus may be used to defray other public expenditures, or to avoid taxation, and only limited distributional or resource allocation problems would arise. Loss-making, on the other hand, may be attacked on the grounds that those who benefit should pay for a service, even though the expenditure of real resources might have taken place in the past.

On the other hand, loss-making (i.e., through the application of SRMC pricing) may entail certain limitations from an efficiency standpoint. First, the accounting losses have to be absorbed somehow, and it will often be difficult to achieve the necessary transfer of real income without creating distortions of consumer or producer choices as severe as those encountered in deviating from marginal cost pricing. Second, the financial discipline and organizational autonomy resulting from financial viability are often thought to be the best way to ensure efficient operation of the undertaking concerned.

Solutions to this dilemma have been proposed which have usually tried to obtain the best of both worlds: the resource allocation advantages of marginal cost pricing on the one hand and the achievement of a satisfactory financial performance on the other. There are, in fact, many variations on a common theme, the simplest of which is a two-part tariff where an electricity consumer would pay an amount per KWH consumed equal to marginal cost, plus a lump sum (large fixed charge) covering non-marginal "sunk costs" as well as consumer-related costs. In this way, as long as liability to the lump sum payment does not deter anyone from consuming the system's electricity altogether, optimal allocation may be achieved. It is well recognized that the multi-part tariff (e.g., in the case of electricity supply), which was intended to avoid losses, does not solve the problem either, because it requires that the fixed and the variable costs be imputed to individual consumers which, in reality, is not possible. In this case again the decision taken about the prices to be charged must involve a value judgement about the distribution of income.

Similarly, efficient allocation may theoretically result from the activities of the imaginary "perfectly discriminating monopolist", who charges each consumer a price equal to the maximum the consumer would pay, on down to the consumer who places a value on a KWH equal to its marginal cost.

3.1.3. Third objective:

The third objective is the meeting of income distribution aims. That is, in pursuit of fairness and equity, governments are concerned with the redistribution of income towards the poor. Electricity tariffs must be structured in a way so as to be an effective instrument for achieving this objective.

In fact, socio-political or equity arguments are often advanced in favour of subsidised prices for electricity, especially where the costs of electricity are high relative to the incomes of poor households. In order to ensure that the poor obtain a minimum adequate supply of electricity, it may be desirable to modify the marginal cost pricing approach. This can be done by means of a tariff schedule that is designed in a way to allow for a low subsidised "lifeline" rate (block) for a certain quantity of KWH consumption per month. Marginal cost, however, will be charged for all additional consumption above those of the lifeline or average consumption. This will normally provide an acceptable tradeoff between efficiency on the one hand and equity on the other. However, this issue will be discussed further later in this chapter.

In addition to the above objectives, there are social and economic goals whereby electricity may be supplied to certain to certain sectors of the economy (e.g., industry) at subsidised prices as part of an industrialisation programme. Moreover, electricity may be supplied to certain geographic areas as means of regional development (e.g., rural electrification). In the following, we discuss some of the issues related to the use of electricity in industrialisation.

The goal of rapid industrialisation is subscribed to by almost all the developing countries. Industrial energy demand (and electricity in specific) is a function of the absolute size of the industrial sector, the structure of output, and its energy intensity. In many countries - mostly developing - industrial production and industrial energy demand for over a decade or so have been growing faster than output and energy consumption in other sectors of the economies. Further, there has been an increasing trend towards heavy industry, which is highly energy intensive. In fact, since the 1960's, Egypt has embarked on a rapid industrialisation programme which pivoted upon highly energy intensive industries. That is, most of the electricity consumption in manufacturing (and by large in aggregate electricity consumption) occurs mainly the following four industries: iron and steel, aluminium, fertilisers, and cement. The main point that we have noted previously is that these all have significant energy-saving potential. Since energy costs account for a high proportion of total costs in the above four industries, an increase in the price of electricity could lead to considerable increases in total costs. However, since those energy intensive industries are under public ownership, it may not be possible to allow any product price increases. This may lead to savings in energy in the short-run due to better housekeeping and retrofitting, and more efficient utilization with the existing equipment. In the long-run, it could lead to changes in the techniques of production.

However, there are other less energy-intensive industries such as textiles where it may be thought that governments should encourage their expansion. If this were the only consideration, it might be quite possible to say electricity should be provided to them at subsidised rates which are lower than those charged to the energy-intensive industries. In this context, it should be noted that in most countries, the so called "small-scale industries" sector accounts for a sizeable proportion of total output. Although the efficiency with which energy is utilized in this sector is probably lower than in the "organised" sector, the energy requirement per unit of value added is still relatively quite small. From an energy point of view it merits special treatment.

It hardly needs emphasising that changes in electricity prices are not the only, or even the most appropriate, way of influencing industrial structure. Neither, of course, is energy efficiency the sole factor in technological choice. An interesting illustration of this is provided in the manufacture of steel.

3.2. Details of LRMC tariffs:

In general, tariffs have a large impact on demand, i.e., a significant number of customers define their consumption according to the price of supplies. The supplier (distributor) can take advantage of this to alter the shape of the load curve (demand at all times) and influence the total cost of electricity generation and distribution. Therefore, pricing guides demand "at best".

The marginal cost approach permits a high degree of tariff structuring. However, practical constraints and the need to simplify metering and billing procedures usually require that tariffs be differentiated only by:

a) principal customer categories - residential, industrial, commercial, etc...

b) voltage levels - ultra high, high, medium, and low.

c) time of day - peak and off-peak.

Various other constraints may also incorporated into tariffs based on marginal costs, e.g. the political requirement of having a uniform national tariff, subsidising the poor, etc...

Whenever appropriate, these elements of LRMC must be broken down by time of day, voltage level and principal customer categories.

After identifying the conflicting objectives and requirements of price setting above, we present in this section the recent theoretical developments in the calculation of LRMC based tariffs. In a nut-shell, the LRMC approach has both the analytical rigor and inherent flexibility to provide a tariff structure which is responsive to the above mentioned basic objectives [56]. Since the above objectives usually conflict with each other, it is normal to proceed first with the efficiency criteria and then adjust our pricing framework afterwards in order to allow for the other objectives as described below.

3.3. Methodology for the calculation of LRMC based tariffs:

The methodology for the calculation of LRMC tariffs can be summarized in the following three stages:

Stage 1:

The strict LRMC is calculated whereby the economic (first best) efficiency objective of tariff setting is satisfied. There are four components of marginal costs in the calculation of the strict LRMC:

a) marginal capacity costs;

b) marginal energy costs;

c) marginal consumer costs; and

d) marginal external costs

The marginal capacity costs (also known as demand related costs) are the costs of expanding capacity to meet incremental demand. That is, the costs of investment in generation, transmission and distribution facilities needed to supply additional kilowatts. From the national perspective, however, it is defined as the costs to society of the actions taken by the electric power utility to meet a sustained increase in demand. This type of cost - which is also known as the quality of supply costs - correspond to the value of energy not provided to the customer either due to a generation or network capacity shortage or some other constraint. In short, it is the cost of system reliability. There are mainly two ways of calculating the quality of supply costs:

i) marginal capital costs to install additional capacity by the electricity utility.

ii) customer costs incurred by unserved energy. Apart from externalities (e.g., incremental pollution), the costs of an increase in demand are the incremental capacity costs, net of fuel savings, incurred by the utility, and the cost of incremental outages incurred by the consumers [3].

Marginal energy costs (may be known as energy related costs) are the marginal generation fuel costs and marginal generation and network maintenance costs (i.e., variable operating and maintenance costs) required to produce an additional KW from the system. Such energy related costs vary with the number of units used by electricity users, their major cost, however, being fuel. For a thermal plant, these energy costs consist of fuel and variable operating and maintenance costs needed to provide additional kilowatt-hours, whereas for a hydro-electric system, a part of the investment cost associated with storage may be related to energy [68].

Thirdly, marginal consumer costs are the incremental costs directly attributable to consumers, including costs of hook-up, metering, and billing. Such costs neither vary with consumption nor with maximum demand. In fact, they are usually recovered through a standing charge.

Finally, the typical external costs relevant to electricity usage are pollution. Therefore, the marginal external costs are those associated with the costs or benefits resulting from electricity supply and use. The costs can be considered as the abatement costs needed to ameliorate the negative effects engendered through thermal electricity generation such as the measures needed to counter excessive emissions of CO_2 and SO_2 into the environment. Appendix A2 presents a brief review of these external costs.

Whenever appropriate, these four marginal costs categories of LRMC must be broken down by time of day, consumer categories, voltage levels, geographic areas, and so forth [56]. Usually, energy related costs are broken down by time periods (e.g., by hour, by day, by season), while demand related costs can be split between those for generation and for distribution. The latter costs can be broken down further by voltage level.

Stage 2:

There are a number of arguments which suggest the necessity of making a departure from setting electricity prices equal to the strict LRMC. That is, if prices were set equal to it, first, consumers could indicate their willingness to pay for more consumption, thus signalling the justification of further investment to expand capacity. Second, there are other objectives besides the economic efficiency objective which have to be satisfied by the tariff structure; in a previous section we elaborated on those objectives especially the ones relevant for developing countries. In addition, there is an additional complication of setting electricity prices (or indeed any prices) in a distorted economy, a typical case of many developing countries which needs to be considered in formulating any pricing policy. Hence, the rest of this section discusses this difficulty which is known as the second-best problem.

Second-best problem and shadow pricing:

Another difficulty encountered in applying marginal cost pricing to the provision of electricity supplies is known as the second-best problem. In fact, one of the common features perpetuating in a developing country is the presence of price distortions as well as externalities. That is, prices in the economy do not reflect their true economic costs (marginal costs). Not only are there price distortions for electric power substitutes and compliments, most importantly, the prices of capital, labour, foreign exchange, and fuel also do not reflect their true resource costs.

In fact, setting a price equal to marginal cost may appear at first sight to be a step in the direction of economic efficiency while it may not be an improvement over any other pricing mechanism at all should inefficient conditions prevail in other sectors of the economy. Optimality in any one sector might require a price greater or less than marginal cost to counter such inefficiencies. In practice, in any economy in which there is a reasonable degree of competition, it has to be assumed that elsewhere goods and services are sold at prices that in general approximate marginal costs. If not, the difficulties of adjusting for all imperfections would lead to the nihilistic conclusion that there are, after all, no empirical grounds for preferring any one set of pricing rules over any other. Where goods or services that are in direct competition with (or are complementary to) the services in question are priced in a way that diverges sharply from the standard set for the electricity supply system, it may necessary and feasible to make some adjustment.

Thus, a comprehensive study for price determination in a distorted economy will have to use economic opportunity costs (shadow prices) instead of the financial costs. If prices of resources used in electric power generating units (e.g. fossil fuels) diverge from their marginal cost to society, shadow prices should ideally be placed upon them in evaluating the real cost to society of the expenditure. Labour that would otherwise be unemployed might be valued near zero (i.e., at an estimate of its opportunity cost) even though, due to market imperfection, it is able to command a wage rate in excess of the minimum amount needed to attract it; foreign exchange costs should be valued at their market rate; interest rates should reflect the social opportunity cost of capital, and so on. Adjustments of this nature are necessary if the ultimate consumer is to be faced with a price for electricity that reflects the true economic cost which his consumption entails.

Stage 3:

In stage 1, we presented the four major components for the calculation of the strict LRMC of electricity supply which would more-or-less ensure the efficient allocation of resources. However, it is necessary for the electricity utility to adjust those LRMC estimates in order to satisfy the other objectives - beside economic efficiency - it may pursue (within the context of the overall objectives of the government). We also discussed the need for using shadow prices whenever possible in situations where prices in the economy do not reflect their true opportunity costs; a case relevant for most developing economies. In the final stage, however, the LRMC estimates adjusted for all the above constraints, will have to be translated into suitable tariffs. In achieving such a task, one first has to strike a balance between having a simple tariff which is cheap to meter and a very precise reflection of costs which would be more costly to meter. Despite that many countries would like, in general, to pursue the former objective, it is very unlikely that the implementation of such simple tariffs would be fair between individual consumers. Where a relatively small amount of electricity is consumed - as may be the case in residential consumption - simple tariffs could be justified on the grounds of minimising metering costs. In general, the higher the consumption, the more complex metering could be justified. In the proceeding argument, we will attempt to review briefly the main principles involved in assigning the first three components of the LRMC (i.e., those energy related, demand related, and consumer related) to each tariff group. Within this context, we will split these groups according to their load characteristics into two main categories, residential tariffs and non-residential ones. However, it would be beyond our scope to deal with the marginal external costs.

With regard to residential consumption, load research [68] has shown that when those consumers are grouped into a number of annual consumption bands, the marginal capacity cost (i.e., demand related cost) of the average consumer in each band varies directly with the size of the average annual consumption of that band. In other words, the load factor in relation to the system peak is fairly stable. Thus, one can recommend the implementation of a simple tariff for residential consumers, with both the demand and energy related costs (i.e., marginal capacity and marginal energy costs respectively) being recovered in the unit rate without having to resort to a separate demand charge. However, the marginal consumer costs which are directly attributed to the consumer and neither vary with the amount of electricity consumed nor with the level of demand, make up the standing charge. In fact, simple tariffs have the advantage of avoiding the confusion within residential consumers and also facilitates the metering and billing of their consumption.

On the other hand, the second group of tariffs (i.e., non-residential tariffs) are the ones which apply to all commercial and industrial consumers whose volume of consumption is much greater than that of residential electricity users. In this case, applying a single simple tariff would be very unlikely to recover their associated costs. Therefore, those non-residential consumers would have to be divided into a number of size bands for tariff setting. The limits of each band will have to be determined according to load research on this particular tariff group. However, if the consumption of one group of consumers is relatively too small to justify expensive metering, then it necessitates the application of a simple tariff structure with a standing charge and an initial block of high priced units and a lower follow-on unit price which would reflect the present estimates of costs.[9] In the case of large commercial and industrial consumers, their load characteristics justify charging separately for the consumer's maximum demand and for his consumption of energy, i.e., applying a maximum demand tariff. This particular type of tariff would indicate to the consumer the costs incurred by his consumption more accurately than a simple unit tariff rate. With regard to the much larger industrial consumers, the strict application of the published maximum demand tariff would not produce an adequate nor exact reflection of costs. Thus, a more detailed tariff is needed; one which would be designed to suit the consumer's specific load characteristic.

Once an extensive study has been conducted to structure the LRMC based tariffs on the different groups as we briefly mentioned above, it is then necessary to make forecasts of the total income for the appropriate time-period.[10] At this particular phase, concessions have to be made with regard to satisfying the other objectives the electricity utility may

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[9]That is, if load research on this group of consumers indicates that on average their costs per unit (i.e., per KWH) drop slightly with increasing consumption. This may even be the case for the larger commercial and industrial consumers whose costs per KWH fall on average with the increase in consumption.

[10]It is mostly the financial year in many public utilities.

be pursuing within the overall national objectives of the country. For example, a balance has to be struck between subsidising part of the residential consumption, industrial plants in their early lives, rural electrification programme, while at the same time the electricity utility would be able to achieve an amount of revenue which is required to meet its financial target. Otherwise, the financial viability and autonomy of the utility would be jeopardized. In any case, making adjustments to the LRMC tariffs should ensure that the basic integrity and advantages of marginal cost pricing are maintained, which aim at the equivalence of willingness to pay for the incremental cost of supply at the margin. This is crucial in order to give the correct signals to consumers. Secondly, under no circumstances should the tariff for any consumer group fall below the SRMC levels.

Table (2.1) summarizes the above argument concerning the three different stages embodied in the formulation of the LRMC tariffs.

3.4. Electricity tariffs and considerations of equity and efficiency:

Electricity is often in short supply, with frequent power failures. There is thus a powerful case on equity and efficiency grounds for keeping the price high enough to ration demand by price rather than blackout. However, many developing countries have set out to subsidise

Table (2.1)

Stages of LRMC tariffs

Stage 1	Calculation of: 1) marginal capacity cost 2) marginal energy cost 3) marginal consumer cost 4) marginal external cost
Stage 2	adjusting the LRMCs for any distortions in the economy in order that relevant prices would reflect their true economic values.
Stage 3	making distinctions between different types of consumers, according to their load characteristics. Then, a tariff structure would be formulated, though it will have to be adjusted to meet the financial requirement of the utility, and other objectives it may pursue, most notably, equity considerations.

SOURCE: summarized from section 3.3.

the cost of electricity mainly for the low-income groups in order to satisfy their basic needs of electricity use, a laudable objective as we shall argue in chapter 3.

Nevertheless, in this context, two issues should be noted. First, low-priced, lifeline rates may deviate markedly from economic efficiency criteria. Second, the amount of the subsidy that is to be made available through the lifeline rates must be carefully monitored so that either the revenue of the subsequent higher-priced blocks balances the losses incurred or a sufficiently high subsidy is paid by the government; otherwise, the financial viability of the supply organization will be jeopardized. The issue of equity and efficiency in electricity pricing will be discussed in some detail in chapters 3 and 5.

4. Marginal cost estimates of electricity supply in Egypt:

In Egypt, only few studies have been devoted to the estimation of marginal cost of electricity supply of thermal generating units. Sanderson [73] in 1976, estimated the marginal cost at 14.4 mills/KWH. The calculation, however, was made only on the basis of the opportunity cost of fossil-fuels used in thermal generation, while ignoring the other cost components which deviate markedly from their real values.

In 1980, two studies made an attempt to estimate marginal costs. The Pearce-Whitman-Peida consortium estimated it at 35 mills/KWH, while Norris estimated it at 50 mills/KWH and 40 mills/KWH for high and low voltages respectively. Once again, both studies have allowed for the price of oil products used in electricity generation at their next best alternative uses while not considering the other components of cost relevant in the calculation of marginal cost [84] such as the choice of an appropriate rate of return on investment in the electricity facility, etc...

Another study by Kirtley and Weitzman [88] has advanced a tariff structure based on a prototype marginal generating unit of 300 MW station with a fuel consumption rate of 230 gms/KW of fuel oil. The study utilized various estimates of alternative border prices of fuel oil used in thermal electricity generation in order to account for fluctuations in international oil prices. Moreover, Kirtley and Weitzman made estimates of operating and maintenance costs and made an allowance for various rates of return on capital ranging from 4% to 14%. Based on their estimates for marginal costs where the rates of return to capital cited are 8% and 12%, they proposed a tariff structure for the period 1974 - 1980 in mills/KWH.

The importance of this study appears to materialize from the fact that it accounts for fixed costs (i.e., capacity costs) as well as variable costs (i.e., fuel, maintenance and operation costs). Despite the fact that the study does not attempt to estimate the marginal cost of hydro generation, it may be argued that hydropower in Egypt has reached its maximum capacity and thus any increase in existing capacity to cater for the ever increasing demand for electricity, will have to be accommodated through the building of new thermal generating units.

One of the main criticisms that could be directed to the tariff structure recommended by Weitzman and Kirtley is that it only represents a single tariff which ignores the fact that the cost of producing a KWH varies by the hour[11] and sometimes by the season of the year and therefore these temporal variations have to be represented in the electricity tariff. Charging customers pre-specified prices which do not reflect these costs discourage them from adapting their usage to times of low utility cost and thus contributes to higher costs. In fact, the whole process of generation, transmission and distribution must be designed to meet peak demand. It is then easily understood that the cost of a KWH is highly dependent upon the period during which it is demanded. Therefore, a tariff structure which reflects increasing marginal costs during system peaks and falling ones during troughs would enable consumers of electricity to adjust accordingly and hence act as an incentive to reduce consumption during system peaks which in turn relieves the burden on existing capacity.

Abou Neima, in an unpublished Masters thesis [4], identifies three main components for the purpose of calculating LRMCs of electricity supply in Egypt which have been previously mentioned. That is, the marginal fuel cost,

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[11]A typical case of peak-load pricing where consumers would have to pay variable costs (SRMCs) in addition to incremental capacity costs to account for the constraint they impose on existing capacity.

marginal capacity cost of generation, and marginal capacity cost of transmission.

The marginal fuel cost, defined by Abou Neima [4] as the fuel cost of an additional increment in load during any price period, was calculated for each of the eight periods of the day representing each week dealt with in the simulation model used. The calculations were carried out in terms of the domestic prices of fuel as well as the international ones, where the differences represented the fuel subsidies. However, Table (2.2) presents the marginal fuel costs for both the peak and off-peak periods during the winter and summer seasons where July represents summer, while December represents winter. These results were obtained as a weighted average of the marginal fuel costs for each costing period.

Table (2.2)

Marginal Fuel Cost
(Mills/KWH)

	PEAK		OFF-PEAK	
	Domestic	Inter'l	Domestic	Inter'l
WINTER	16.852	101.018	13.325	82.993
SUMMER	15.898	95.193	2.184	40.898

SOURCE: ABOU NEIMA [4]

The marginal capacity cost of generation which is defined as the unit of investment, and operating and maintenance cost of the generating plant needed to meet the load with the shortest duration at the peak was extensively analyzed in the study where the anticipation cost[12] was calculated. This anticipation cost was then apportioned to the characteristic tariff periods proportionally to the given risk of shortage. The results for the several characteristic tariff periods are presented in Table (2.3).

Table (2.3)

Marginal Capacity Costs
(L.E./KW & Mills/KWH)

	Capacity cost for the annual tariff period L.E./KW		Cost for each KWH of the tariff period Mills/KWH	
	PEAK	OFF-PEAK	PEAK	OFF-PEAK
WINTER	30.75	7.85	23.0	1.75
SUMMER	11.40	0.0	18.70	0.0

SOURCE: ABOU NEIMA [4]

The study nonetheless advocates that applying a tariff structure in Egypt based on marginal cost can result in a reduction of 5% of peak demand due to the modification of load patterns by consumers who shift their load away from peak time. The outcome would be a total reduction of 336 MW which would realize an annual saving of around L.E. 124

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[12] Defined as the extra cost needed to bring forward a single KW one year early. The components of such a cost were discussed earlier.

million arising from capital and operation costs. Moreover, less additional capacities will be required to cover the increase in loads in future. In addition, the study argues that other benefits will materialize in terms of modifications in the load curves of the system which improves the load factors and thus leads to the realization of better thermal curves. This would eventually end-up in a much improved economic operation of the thermal units.

However, the study does not analyse the trade-off between having such detailed tariff structure which require expensive and sophisticated meters as opposed to having a much simpler tariff which would entail much cheaper meters and less confusion for the consumers. Although there is a discussion of the benefits accruing (i.e., in terms of savings) by implementing these marginal costs, there is no mention of how the other objectives pursued by the electricity utility (and indeed those pursued by the government of Egypt) would be accommodated. In fact, more research would have to be conducted in order to assess the equity and welfare implications embodied in the application of those tariffs. That is, whether households would be worse-off or not whereby if this is the case, then it would be necessary to find other means to ameliorate the negative welfare consequences. Furthermore, the study will have to evaluate the effects of these tariffs on the various economic sectors of Egypt. More importantly, the Abou Neima thesis does not include any study or make any assumptions on the price elasticity of electricity demand in Egypt which is necessary in assessing the impact and magnitude of any tariff change.

Our own contribution with regard to marginal cost calculation, we used detailed dis-aggregated data for the various economic sectors of Egypt for the years 1982/83 to 1986/87 from CAPMAS [13] and then embarked on calculating the average marginal costs for those sectors. Unfortunately, we only attempted to make these calculations using domestic fuel prices and without any use of shadow prices as this would be beyond the scope of this thesis. Table (2.4) presents the marginal costs calculations which could also be found in Chapter 3 in some detail.

5. Summary and conclusions:

A pricing system which meets the marginal conditions will yield a greater welfare than a pricing system which fails to meet these conditions. Marginal cost pricing is supported on the basis that it meets these marginal conditions and therefore yields a maximum welfare. Tariffs based on marginal costs are concerned with the resource commitments required to meet an increase in demand, are forward looking. This is in contrast to tariffs which are based on average accounting costs (sunk costs), which are backward looking. The latter may bear little relation to the resources required to meet an increase in demand.

TABLE (2.4)

MARGINAL COSTS OF ELECTRICITY SUPPLY
VARIOUS VOLTAGES & SECTORS
IN EGYPT, 1982/83-1986/87
(MILLS/KWH)

	1982/83	1983/84	1984/85	1985/86	1986/87
KIMA FERTILISER	12.9	13.8	14.7	14.5	21.2
ALUMINIUM CO	12.9	13.8	14.7	19.0	21.2
SOMED PIPELINE	12.9	13.8	14.7	20.3	21.2
CEMENT CO	----	10.0	12.3	20.3	21.2
AVERAGE ULTRA HIGH VOLT	12.9	12.9	14.1	18.5	21.2
INDUSTRY	14.9	15.9	16.9	22.7	23.8
CEMENT	14.9	15.9	17.6	22.7	23.8
AMEREIA TEXTILE	14.9	15.9	17.0	22.7	23.8
MIRATEX TEXTILE	----	18.0	16.8	22.7	23.8
AGRICULTURE	14.9	14.9	16.9	22.7	23.8
GOVERNMENT	14.9	15.9	17.2	22.7	----
AVERAGE HIGH VOLTAGE	14.9	16.1	17.1	22.7	23.8
CEMENT	26.0	27.6	29.0	36.1	37.9
SALHEIA PROJECT	21.9	23.5	13.9	17.5	18.8
AVERAGE MEDIUM VOLTAGE	24.0	25.6	21.5	26.8	28.4
INDUSTRY	26.9	28.9	30.5	37.8	40.3
RESIDENTIAL	31.1	33.6	35.3	43.1	45.7
AGRICULTURE	23.9	25.6	24.7	38.9	44.3
UTILITIES	25.5	20.1	29.4	35.9	36.6
GOVERNMENT	31.1	33.6	37.1	44.2	45.7
OTHERS	20.0	21.6	23.5	29.0	36.2
AVERAGE DISTRIBUTION CO	26.4	27.2	30.1	38.2	41.5
OVERALL AVERAGE	19.5	20.4	20.7	26.5	28.7

SOURCE: COMPILED FROM CHAPTER 3, TABLE (3.13)

In general, the efficient price of electricity is the SRMC if operating below full capacity. However, such a pricing principle entails many difficulties in practice which results in the recommendation by many to abandon this approach altogether and use the LRMC approach instead. Some of these difficulties are the realization of financial losses, and the instability of tariffs based on SRMCs. Nonetheless, the dichotomy of setting prices of public utilities at either the SRMC or LRMC can be resolved depending on specific issues relating mainly to the time horizon sought by the price tariff. In the foregoing discussion we showed that there is support in the electricity industry for a longer time-horizon. This is of particular relevance to many developing countries who find it necessary to maintain price stability and avoid large price fluctuations especially for staple food and energy products. Furthermore, we showed that in situations where there is a continuous pressure to increase electrical capacity to satisfy increasing demand, it would be justified to incorporate capacity costs in electricity prices in order to reflect the incremental cost of capacity. Hence, we recommended the use of the LRMC approach in electricity pricing. However, pricing and investment decisions in the electricity industry, especially in developing countries, have to be made in the context of uncertainty; limited or no information on certain issues; price distortions; technical feasibility; imperfect institutions; a need for prices to be simple and relatively stable; and a number of constraints from political, financial and equity objectives. We were, nevertheless, able to show that the LRMC approach satisfies the economic (first best) efficiency objectives. However, the efficiency objective, which requires consideration of geographical and locational cost variations, and compensation for market failure, has to be reconciled with a number of other objectives of the pricing policy. These include equity (mainly to ensure that the poor are not denied minimum levels of service), advancing rural electrification projects, promoting certain industries, and the financial viability of the electricity authority itself. In fact, any LRMC based tariff is a compromise (trade-off) between the many different conflicting objectives.

We find it necessary, however, that the electricity sector's pricing and investment decisions should be analyzed within the overall integrated framework of the country's energy sector. This may be of some relevance to developing countries due to their experiences of poor investment decisions in the electricity sector which in effect had severe implications on some of their economies. In fact, careful tariff design and a balance in project selection can enable governments of developing countries to ensure that the living standards of the poor majority can rise without significant loss of efficiency.

In this Chapter, we also presented a methodology for calculating the LRMCs. This methodology entailed the identification of four major components of marginal costs; i.e., marginal capacity costs (demand related costs), marginal energy costs (energy related costs), marginal consumer costs (consumer related costs), and marginal external costs which are associated mainly with pollution and other externalities. Appendix A2 contains further details on the latter type of costs which are becoming increasingly important in the identification and calculation of marginal costs of electricity supply. Furthermore, we showed that each of the consumer groups would have to be dealt with separately in tariff structuring according to their own load characteristics. At this stage, however, one has to asses the feasibility of applying simple tariffs which are cheap to administer and meter, and avoid confusion, or applying on the other hand, a more detailed tariff structure which would reflect the costs more precisely though would be more expensive to meter. Finally, the electricity utility would have to make forecasts of future revenues for their financial year and according to which they may decide to adjust the prices in order to meet their conflicting objectives. As most economies of developing countries are characterized by the presence of price distortions, we pointed out the necessity of correcting for these distortions by using appropriate shadow prices. In any case, the final set of tariffs must maintain the basic integrity and essence of the marginal cost principle so as to be able to indicate to the consumers the true economic costs incurred by their consumption decisions.

With regard to equity, many developing countries set out to subsidise the cost of electricity for the low-income segments of the society as well as extend electrification to rural areas. The issue of equity will be touched upon in the next chapter in some detail.

In the final part of the chapter, a review of the significant studies aiming at the calculation of marginal costs in Egypt was presented. One of the more recent studies was that by Abou Neima, who estimated marginal costs using both domestic and international prices of fuel. In the study, an effort was made to split marginal costs into peak and off-peak time, in addition to differentiating between summer and winter seasons. An additional effort was made by the author to calculate the average marginal costs for the years 1982/83 to 1986/87 based on the data available to date. However, the calculations were based on the domestic prices of fuels which are heavily subsidised. The reason why we did not adjust our calculations to the international prices of oil is due to the price distortions present in the Egyptian economy which necessitate the use of shadow prices. However, the use of shadow prices are beyond the scope of this thesis.

It is clear from the discussion in this chapter that although some attempts were made to calculate the marginal costs of electricity supply in Egypt, there is still an urgency for a detailed study to calculate these costs based on using shadow prices to account for the true economic costs associated with the electricity industry.

APPENDIX A2

ELECTRICITY GENERATION AND ENVIRONMENTAL COSTS

Environmental costs arise in a number of ways when electric power is generated. There are several environmental impacts of main sources of electricity; oil, gas, coal, hydropower, and nuclear power. The environmental costs can be considered as the abatement costs needed to ameliorate the negative effects engendered by electricity generation, such as, the measures needed to counter excessive emissions of CO_2 and SO_2 into the environment. The emissions of CO_2 are of considerable significance due to their direct contribution to the greenhouse effect. Nonetheless, pollution costs (mainly through air pollution which result from high sulphur fuels) may be more significant in large metropolitan areas, mainly in terms of the effect on health . Moreover, the construction of reservoirs can lead to a serious deficiency in soil nutrients and reduced stock in fisheries, as seen in Egypt after the construction of the High Dam.

On the other hand, there could be some external benefits present where the increased use of electricity instead of fire-wood may reduce the over-cutting of timber resources needed for fuel, thereby reducing soil erosion, recurrent flooding or reservoir siltation. Yet, even though this particular component of marginal cost is relevant to both developed and developing nations, there is very little concern even in the former, leave alone in the latter nations.

Despite the pressing need in developing countries to take systematic account of environmental factors in energy planning, current procedures are inadequate in many cases [48]. The valuation of environmental impacts have to include damage to property and productive capacity as well as the loss and pain and suffering felt by the human beings as a result of the deterioration of the environment. In principle, all these impacts can be quantified in monetary terms and a great deal has been done both theoretically and empirically on the valuation of these effects in developed countries. If these environmental effects can be valued, they should be added to the costs of a particular power source, whose minimisation should provide the basis of choice between alternative investments to meet increased demand.

For instance, the environmental costs of hydropower development being less easily identified are, therefore, less easily mitigated. A cost-minimisation exercise which included the costs of air pollution control but not the social costs of hydropower development would clearly be biased against fossil fuels.

When environmental issues are explicitly considered in any power systems planning model, however, the results have to be interpreted with care. Two key points should be noted in the context of the treatment of environmental costs in developing countries. First, there is already a considerable amount of interest in the use of energy planning models with environmental features in those countries. The second is that there is no single model of power systems planning that is directly applicable and that will provide the answer to the questions raised within the context of environmental costs.

The training of planners and decision-makers both in the operation of the models and in the interpretation of the results is, thus, vital. An important result of such an exercise will be better communication and understanding between the electricity authority (or energy authority, in general) in a given country and those responsible for the environment.

CHAPTER THREE

THE STRUCTURE OF ELECTRICITY SUBSIDIES IN EGYPT

1. Introduction:

A subsidy can simply be defined as a direct or indirect payment or economic concession made by the government to any of its economic agents whether firms (private or public), households, or even other governmental units, for the purpose of promoting public objectives ([6] & [49]).

In the case of Egypt, subsidies were first known to be introduced during World War II, when prices of raw materials and staple food had increased substantially. By introducing the subsidies, the government of the day aimed to insulate consumers as well as businesses from the massive impact of price increases. Since then, subsidies have assumed a much greater potential and, despite their introduction as a temporary phenomenon, a much more intensive subsidy programme has been adopted throughout the years.

In fact, it has become widely accepted in many economic circles in Egypt and in several multi-lateral financial institutions (such as the World Bank) that a great deal of the ailments perpetuating in the economy and manifested in the chronic balance of payments deficits, inflation, and ever-increasing budget deficits among other things, are all a direct consequence of the adoption of the subsidy programme. Such a belief has led to the strong recommendation of abolishing the subsidy programme altogether and finding alternative means through which the market mechanism can function properly and prices determined accordingly, provided that the low-income and poor segments of the society are not made worse-off.

However, one has to point-out that reviewing the development in subsidies can quite often be misleading in the sense that it would not present a sufficient or complete insight to the real magnitude of the subsidy and its direct impact. This is due to the fact that the implementation of subsidies quite often does not incur immediate public expenditure. Moreover, it entails many ramifications throughout the entire economy, which hinder any attempts to trace the impact of the subsidy and its pecuniary implications.

A major part of the subsidy programme in Egypt is directed to the energy sector. As we shall demonstrate later in this chapter, despite the fact that the total subsidy bill has declined in the last few years, the energy subsidy - more precisely, that on electricity, has increased significantly. That is, while the government has attempted to phase-out subsidies gradually, it appears that it has been unable to gain much ground in the electricity sector, despite a series of successive electricity price increases in the last few years. We will also argue that the considerable decline in the subsidy for oil is mostly the result of the slump in its international prices and not, to any great extent, the result of government action.

Within the context of the earlier definition, a subsidy may be defined more precisely as a system through which the government guarantees the provision of goods and services to final users (consumers), intermediate users (production units) at prices below their true cost of production, or below their scarcity price or opportunity cost represented in their international prices. Furthermore, this chapter will focus on the issue of implicit subsidies which are central to the energy sector, and in particular to the electricity sub-sector. Our main objective is to investigate the main cost of the electricity subsidy to the entire economy. However, since the prices of energy in Egypt operate within the framework of a system of economy-wide subsidies, we find it crucial to present an overview of the evolution of the subsidy system in Egypt in addition to its impact on the economy. Therefore, in the section to follow (i.e., section 2), we will discuss some of the relevant issues associated with the introduction of subsidies. That is, we will elaborate on the objectives sought in the introduction of subsidy programmes in general. In addition, we will identify the various types of subsidies and then monitor some of their developments in Egypt in the last decade or more. Finally, section 2 will discuss some of the conceivable economic effects of the subsidy programme on the Egyptian economy. The third section will be devoted entirely to energy subsidies. First a brief discussion on oil subsidies will be presented. Then, the rest of the section will analyze the structure of the electricity subsidy and its magnitude by sector as well as household. In the fourth section, we will raise some of the issues associated with the use of subsidies in electricity pricing where some conflict evolves on attempting to achieve efficiency pricing while at the same time pursuing certain equity objectives in supplying electricity to the poor segments of society. In this context, we will make certain recommendations which can reconcile these conflicting objectives.

2. Subsidies in Egypt:

2.1. Preamble:

Despite the fact that subsidies were first introduced in Egypt in the 1930's, they started to assume greater importance after the socialist revolution of 1952 and in the decades to follow. The implementation of this programme was justified in terms of the benefits accruing to the population through the use of this instrument. However, the subsidy programme has been severely attacked on the grounds that it has led to many manifestations of resource mis-allocation.

The emergence of the subsidy system with all these dimensions is a clear indication of the inadequacy of the taxation system in Egypt. Had subsidies been financed by taxes, many of the adverse effects would have been mitigated, while the favourable distributional aspects of subsidies would have materialized [72].

In Egypt, the share of the food subsidy represents a substantial part - if not the bulk - of the total direct subsidy bill which was 40% in 1982/83, increasing to 43% in 1986/87 as shown in Table (3.1). In real terms, however, this represents a decline of almost 60% during the period 1982/83 to 1986/87 as indicated by the same Table.

2.2. Objectives of subsidy policies:

The main aim of the subsidy - irrespective of its specific type - is to change the outcomes brought about otherwise by free markets and unimpeded competition in a direction considered more consistent with the objectives of public policy [49]. Mesreka 1985 Ph.D. CAIRO

The goals sought by the introduction of the subsidy programme in Egypt can be briefly outlined in the following [49]:

a) alter relative prices in such a manner as to affect the redistribution of income favourably.

b) stabilize the prices of key wage goods in order to moderate the demand for higher wages and encourage overall price stability.

c) dampen the increase in the prices of imports especially those necessity goods imported for the poor and low-income groups.

d) improve the level of hygiene and nutrition for the population.

e) protect certain industrial projects as a matter of

TABLE (3.1)

STRUCTURE OF TOTAL SUBSIDIES IN EGYPT
1982/83 - 1986/87
IN CURRENT & 1982/83 000'S L.E.

YEAR / ITEM	1982/83		1983/84			1984/85			1985/86			1986/87			PERIOD GROWTH	
	VALUE	SHARE	NOM	REAL	SHARE	NOM	REAL	SHARE	NOM	REAL	SHARE	NOM	REAL	SHARE	NOM	REAL
FOOD STUFFS*	1526	40%	1922	1744	44%	1652	1325	40%	1404	960	43%	1034	622	43%	-32%	-59%
P. TRANSPORT	38	1%	56	51	1%	71	57	2%	69	47	2%	94	57	4%	147%	49%
PETROLEUM	1715	45%	1814	1646	42%	1734	1390	42%	1071	732	33%	668	402	28%	-61%	-77%
ELECTRICITY	230	6%	245	222	6%	163	131	4%	321	219	10%	361	217	15%	57%	-6%
BANK CREDIT**	115	3%	120	109	3%	132	106	3%	159	109	5%	124	75	5%	8%	-35%
TEXTILES	156	4%	127	115	3%	170	136	4%	143	98	4%	63	38	3%	-60%	-76%
MEDICINE***	28	0.7%	20	18	0.5%	21	17	0.5%	8	5	0.2%	5	3	0.2%	-82%	-89%
OTHERS	34	0.9%	46	42	1%	58	47	1%	76	52	2%	93	56	4%	174%	65%
TOTAL	3842	100%	4348	3946	100%	4101	3288	100%	3251	2222	100%	2397	1442	100%	-38%	-62%

NOTES: * BOTH ON DOMESTIC & IMPORTED FOODS
** THAT IS, BANK OF AGRICULTURAL & CO-OPERATIVE CREDIT
*** INCLUDES MILK FOR CHILDREN

SOURCE: 1) CAPMAS [13], FOR DATA ON SUBSIDIES IN EGYPT
2) CAPMAS [12], FOR DEFLATORS

national interest and also to ensure their continuity.

The above objectives are not mutually consistent with each other and thus any subsidy policy can only be designed to trade-off between them.

2.3. Types of subsidies:

Two main types of subsidies are recognized. First, direct subsidies which are also known as explicit subsidies[1] and indirect subsidies.

Although direct subsidies as mentioned previously, emerged in Egypt as early as the late 1930's, they were recorded separately in the government budget as an expenditure item only in the fifties. In fact, they are recorded explicitly in the budget as subsidy appropriations and subsidy for reducing the cost of living. This subsidy entails financial grants or other transfer payments or aids designed to promote public objectives.

Indirect subsidies are composed of five main categories:

1) Controlled price subsidies:

With regard to this particular sub-category, it can be divided into two types; indirect controlled price subsidies and implicit subsidies.

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[1]In some of the literature, they may be called financial or budget subsidies due to the manner in which they are recorded in the fiscal state budget.

a) indirect controlled price subsidies represent the difference between the cost of domestic production of goods and services and their corresponding fixed sale prices. This type of subsidy results in treasury transfers to cover the current deficits of the public economic authorities. This subsidy is reflected in part in the decreased profits realized by the public sector companies as a percentage of capital relative to profits, in contrast to that earned by other comparable units engaged in the same activities.

The current deficits of public economic authorities in Egypt have been growing considerably in the last decade or more, increasing from L.E. 344 million in 1980/81 to L.E. 1683 million in 1988/89, representing an increase of almost 4 fold in nominal terms and of around 29% in constant prices ([12] & [15]).

b) implicit subsidies which are represented in the opportunity cost resulting from the domestic sale of raw materials, intermediate goods or final products to production units or consumers at prices below their international equivalents or marginal cost. These are of specific relevance in the energy sector and thus will be discussed in some detail in the next section of this chapter.

2) Exchange rate subsidies whereby some accredited importers were given the right to import certain types of commodities

at the over-valued official exchange rate rather than the parallel exchange rate. This particular type of subsidy was mainly intended for cushioning domestic consumers of staple food from the unnecessary price rises of imported food as a consequence of the lower exchange rates of the parallel currency market. However, through the unification of the multiple exchange rate system as well as the flotation of the Egyptian pound in recent years, this kind of subsidy has been abolished and as a direct result, domestic inflation and especially consumer prices of food stuffs has increased massively.

3) Tax subsidies which represent certain forms of tariff exemptions granted to some importers. Other forms of tax subsidies include tax credits, differential tax rates and special tax concessions.

In Egypt, under the law 43 of 1974, joint ventures and free zone companies are granted five years tax concession and are granted an exemption from import duties as well. Such measures were introduced to act as incentives for attracting foreign capital via foreign direct investment and multi-national corporations.

4) Levying import tariffs on certain commodities thus acting as a form of effective price support for particular domestic industries. The reasoning behind imposing these tariffs is usually to protect infant industries at their early stages.

On the other hand, governments may impose such tariffs if they have reason to believe that their overall levels of employment, income and profits are threatened by more competitive foreign imports.

5) Free or low-priced government services where those usually covered by the subsidy programme may include housing, transportation, agriculture, mining, health and education. Throughout the years, the Egyptian government has been burdened by huge expenditure outlays for those sectors especially the ones who do not generate any revenues, i.e., providing free services, such as education and health which by constitution have to be provided free of charge to all the citizens.

2.4. Economic effects of the subsidy policy:

All the above mentioned subsidy instruments were adopted by the Egyptian government so extensively, that they became complex and pervasive in the system, so as to render futile any attempts for estimating precisely the economic cost of the overall subsidy programme [42]. In fact, the subsidy programme adopted has clearly had negative impacts on both the internal and external balances of the Egyptian economy. That is, subsidized goods give the wrong signals to producers and consumers which in turn result in a wasteful consumption pattern, contracted output and intensive use of subsidized inputs. Such negative consequences are reflected in international trade causing external imbalance via increased imports and reduced exports. Once again, this in turn has led to (or contributed significantly) to the exhaustion of Egypt's foreign exchange resources and thereby adversely affecting the balance of payments, amplifying the annual budget deficit and thereby suppressing investment potentialities, fuelling domestic rates of inflation, thus reflecting a concealed form of general taxation which intensifies the inequalities in the distribution of income and wealth [42].

In the following, we will attempt to discuss briefly some of the effects of the subsidy programme implemented in Egypt.

2.4.1. Effects on the consumption pattern:

Through the introduction of subsidies, domestic prices become distorted. That is, subsidized prices do not reflect their true economic costs which in effect represent the real value to the economy. More specifically, explicit subsidies divert prices from actual cost of production, while implicit subsidies make them deviate from their opportunity costs.

As consumers are given the wrong signals through the subsidized prices, they consequently direct their expenditure towards subsidized goods while shifting away from the other non-subsidized ones. Such an altered trend in consumption leads in effect to an intensive consumption of subsidized goods relative to the consumers' nominal incomes. The increased demand eventually leads to shortages and inevitably to a black market.[2] Shortages of supply can be met by increased imports. However, this affects the balance of payments significantly and drains the nation's scarce foreign exchange. Low domestic energy prices could be cited as an example in this respect where in the case of Egypt, subsidized energy prices leads to excessive demand for energy and thus, reduces the exports of oil.

2.4.2. Effects on the production pattern:

In the case of a controlled price subsidy, subsidized goods are less profitable than the non-subsidized ones and thus producers have less incentive to produce more of the subsidized goods. Not only do producers have less incentive to produce the subsidized goods, traders as well have less incentive to trade in them for the very same reason. In general, the markets for price controlled subsidized goods are mostly characterized by excess demand, shortages and black markets, goods resales and speculation. This is mainly due to reduced production, increased consumption in addition to a distortion in relative prices

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[2] That is, in the case of a price-controlled subsidy whereby there is another price at which buyers and sellers are willing to trade.

between subsidized and non-subsidized goods. The end-result is an inefficient allocation of resources between the production of various subsidized and unsubsidized goods and services as well as an inefficient composition of national production by world standards.

2.4.3. Effects on the production techniques:

Production techniques are affected in the case where intermediate goods are subsidized. In such a case, production techniques become directed towards more intensive use of subsidized inputs in contrast to non-subsidized ones with no consideration to the most efficient methods of production. Distorted relative prices of inputs consequently give the wrong signals to producers and perpetuate a wasteful pattern of input-mix which reverberates throughout the economy by a multiplier effect. The ultimate result is a substantial overall economic and social loss. This will have some relevance in our discussion on electricity generation.

2.4.4. Effects on the government budget deficit:

Direct subsidies directly increase the recorded deficit in the current government budget. However, indirect subsidies increase the budget deficit indirectly by reducing the budget revenues through their repercussive effect throughout the economy. The budget deficit in Egypt has increased from around L.E. 1.4 billion in 1975 to L.E. 7.2 billion in 1988/89 representing a 4 fold increase [15]. In real terms, however, indicates that the deficit has declined by 30% throughout the same period [12].

Through the increase in the budget deficit, subsidies lower the amount of government savings as well as constrain investment appropriations. As the budget deficit is partly financed by external loans, this increases foreign indebtedness. In addition, it contributes to the deterioration of the balance of payments as debt services increase through time. On the other hand, the budget deficit may be financed domestically through borrowing from the banking system. Internal borrowing coupled with an ever-increasing subsidy bill may lead to a higher rate of money creation far in excess of the public demand for money, hence increasing the rate of inflation.

2.4.5. Effects on the balance of payments:

The burden the subsidy programme imposes on the balance of payments is recorded by the increasing volume of imported subsidized goods in proportion to the total volume of imports. Such a situation has been negatively reinforced over the last few years by the substantial growth in both consumption and population. In fact, not only did consumption rates increase, the pattern of consumption changed in favour of subsidized goods (both domestic and imported) as well. With regard to oil, due to the high implicit subsidies placed on its products, overall consumption of oil has increased throughout the years which led to reduced quantities made available for exports. This in turn has meant lowered revenues of exportable oil. Moreover, the balance of payments deteriorated yet further as the international prices of imported subsidized goods increased, in addition to the devaluation[3] of the domestic currency. Finally, the inability of the export sector to expand vis-a-vis the expansion in the import bill also added to the deterioration of the balance of payments. The ultimate result, in addition to the worsening of the balance of payments, is a massive demand for foreign exchange in excess of supply required to meet this trend.

2.4.6. Effects on income distribution:

As outlined earlier, one of the main objectives of the subsidy policy is to achieve a more favourable income distribution. Basically, the effects of subsidies on income redistribution pivot upon the income elasticity of demand of the subsidized good. In the case of subsidizing a low income elasticity good such as food results in an income redistribution from the high-income groups of the population to the lower-income ones who spend a major

[3]Before the partial flotation of the Egyptian pound in 1987, the currency was constantly pegged by the government.

proportion of their income on the consumption of food.

On the other hand, if goods with a relatively higher income elasticity are subsidized, as in the case of implicit subsidies on energy products, the situation is reversed. That is, the redistribution of income will tend to be from low-income groups to the higher ones. In such a case, the rationale behind subsidization would be undermined.

Overall, one has considerable suspicions regarding the achievement of income redistribution in Egypt through the implementation of the intensive subsidy programme. This is mainly due to the fact that most of the targeted groups (i.e., worse-off segments of the society) either do not receive the subsidy initially designed for them or have to compete with the better-off ones to obtain the subsidized goods at black market prices. In fact, all forms of subsidies in Egypt are unfortunately not restricted to the low-income or the poor (i.e., open-ended). Instead, the rich enjoy the subsidies and thus, compete with the poor for them. A simple example would be that of gasoline where the subsidy per litre is the same whether it is used in a Rolls Royce or a Skoda.

In fact, a direct subsidy typically has the effect of reducing the price and increasing the quantity supplied. However, the extent of the reduction in price and the increase in quantity depends on the elasticity of the demand and supply curves; that is the incidence of subsidies.[4] The

[4]This type of analysis is originally applied in taxation in order to find out who bears the greater incidence or brunt (continued...)

steeper the demand curve or the flatter the supply curve, the more the consumers will benefit from the subsidy. In the reverse case where the flatter the demand curve or the steeper the supply curve, the more the producers will benefit from the subsidy.

Table (3.2) summarizes few of the main economic effects of implementing the above subsidy tools in Egypt.

3. Energy subsidies in Egypt:

The Egyptian government has kept energy prices low through the implementation of an overall subsidy programme. The government, in an attempt to insulate its economic sectors, practices a policy of price controls on indigenously produced energy in addition to subsidizing imported energy. For over a decade, however, it has been subjected to an increasing pressure from multi-lateral financial institutions to move energy prices towards their international levels.

The underlying reasons for raising energy prices can be summed up in the two principles of allocative efficiency and resource mobilization [62]. That is, raising energy prices to reflect their scarcity levels will affect energy-using investment decisions by providing the correct economic rates of return rather than distorted ones had low energy prices

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[4](...continued)
of the tax whether it is the producer or consumer. However, the same analysis could be applied in the case of subsidies.

TABLE (3.2)

SUMMARY OF SOME ECONOMIC EFFECTS
OF VARIOUS FORMS OF SUBSIDIES
INTRODUCED IN EGYPT

EFFECT / SUBSIDY TYPE	CONSUMPTION	PROD'N TECHNIQUE	GOVERNMENT BUDGET	INCOME DISTRIBUTION	BALANCE OF PAYMENT
DIRECT	NEGATIVE	SMALL	NEGATIVE ENTAILS PAYMENTS AND /OR GRANTS OF MONEY	POSITIVE DESIGNED TO REDUCE COST OF LIVING	NEGATIVE CONSUMPTION GROWS T.BALANCE WORSENS
CONTROLLED PRICE	NEGATIVE EXCESSIVE DEMAND = BLACK MARKET	NEGATIVE DISINCENTIVE FOR IMPROVED METHODS	NEGATIVE REDUCED PROFITS OR FOREGONE OPPORTUNITY	POSITIVE DESIGNED TO IMPROVE BUT EFFECT NOT KNOWN	NEGATIVE REDUCED EXPORTS T.BALANCE WORSENS
EXCHANGE RATE	NEGATIVE DUE TO LOW PRICES OF IMPORTS	SMALL MOSTLY USED FOR IMPORTS OF FOOD	NEGATIVE	POSITIVE DESIGNED TO IMPROVE BUT EFFECT NOT KNOWN	NEGATIVE REDUCED EXPORTS T.BALANCE WORSENS
TAX CONCESSIONS	SMALL NO DIRECT EFFECT	POSITIVE INCENTIVE FOR IMPROVED METHODS	SMALL THOUGH REDUCED TAX REVENUE FROM FIRMS	POSITIVE EVENTUALLY INCREASE EMPLOYMENT & INCOME	POSITIVE IMPROVE IF PROD'N & EXPORTS INCREASE
IMPORT TARIFFS	POSITIVE REDUCED IMPORTS	NEGATIVE LESS FOREIGN COMPETITION	POSITIVE DUTY REVENUE INCREASE AS A RESULT	NEGATIVE HIGH-PRICED IMPORTED AND DOMESTIC GOODS	POSITIVE REDUCED IMPORTS IMPROVE T.BALANCE
FREE SERVICES	POSITIVE EXCESSIVE DEMAND & LOW-QUALITY SERVICE	SMALL	NEGATIVE EXPENDITURE INCURRED & LOW OR NIL REVENUE	POSITIVE TO PROMOTE HEALTH & BETTER EDUCATION	SMALL

SOURCE : SUMMARIZED FROM SECTION 2.4

been used instead. Secondly, by raising energy prices, domestic consumption is reduced, which in turn saves energy resources to be used in a more productive manner locally or to be otherwise exported, thus spurring Egypt's foreign exchange revenues. That is, low highly subsidized energy prices have encouraged excessive energy consumption which as a consequence reduced the quantity of oil available for export and thus, worsening the trade balance on the one hand and the budget deficit on the other whereby the cost of reducing energy prices implies foregone government revenues.

In general, it has become widely accepted in recent years both within the official circles of Egypt and outside, that most of the structural imbalances in the economy were engendered by the massive subsidies especially those of energy. In fact, as the government of Egypt attempted to negotiate for new loans or even reschedule existing ones, the basic prescription recommended by the multi-lateral institutions[5] was the total abolition of all forms of subsidies on energy over a number of years. As we will show in this section, the energy subsidies constitute a major share in the overall implicit subsidies in Egypt. Despite the fact that oil prices were declining significantly by the early 1980's, there is clear indication that subsidies in this sector were not declining proportionally in spite of the government's efforts to increase energy prices successively.

In fact, one can make few remarks by glancing quickly at

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[5]Mainly the World Bank and the IMF.

energy prices in Egypt presented in Tables (3.3) and (3.4) whereby the latter presents the index values for growth in nominal and real prices of energy products in Egypt for the period 1978 - 1989. Table (3.3) presents the prices of the six major oil products consumed in Egypt in both nominal and real terms for the period 1978 - 1989 in addition to electricity prices (only up to 1987 due to lack of more recent data). From the Table, it is quite clear that, apart from the price of LPG which has remained constant throughout that period, all the other prices have increased in nominal terms with average rates ranging from 2% to 20% per annum.

Nonetheless, in real terms, the same Table indicates that all the prices of the six oil products except for gasoline and fuel oil have declined during the period 1978 - 1989 with LPG recording the highest decline of over 80%.

With regard to average electricity prices, Table (3.3) indicates that they have increased by over 90% in nominal terms during the period 1978 - 1987 at an average growth rate of around 8% per annum. In real terms, however, the average price of electricity has declined by over 36% over the same period, at an average rate of 4% per annum.

In the discussion to follow, we will first briefly analyse the major issues involved in the subsidies granted by the oil sector in Egypt. Nonetheless, we will then attempt to discuss the structure of subsidies in the electricity sector in some depth.

TABLE (3.3)

NOMINAL & REAL PRICES OF ENERGY PRODUCTS IN EGYPT
1978 - 1989
(IN 1978 PRICES)

PRODUCT	LPG		GASOLINE		KEROSENE		GAS OIL		DIESEL		FUEL OIL		ELECTRICITY	
	MILLS/BOTTLE		MILLS/LITER		MILLS/LITER		MILLS/LITER		MILLS/LITER		L.E./TON		MILLS/KWH	
YEAR	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL
1978	650	650	71	71	25	25	25	25	21	21	7.5	7.5	8.6	8.6
1979	650	568	86	75	30	26	30	26	26	23	7.5	6.6	7.4	6.5
% GROWTH	0%	-13%	21%	6%	20%	5%	20%	5%	24%	8%	0%	-13%	-14%	-25%
1980	650	497	96	73	30	23	30	23	26	20	7.5	5.7	7.5	5.7
% GROWTH	0%	-13%	12%	-2%	0%	-13%	0%	-13%	0%	-13%	0%	-13%	1%	-11%
1981	650	459	120	85	30	21	30	21	26	18	7.5	5.3	7.4	5.2
% GROWTH	0%	-8%	25%	15%	0%	-8%	0%	-8%	0%	-8%	0%	-8%	-1%	-9%
1982	650	420	130	84	30	19	30	19	26	17	7.5	4.8	7.6	4.9
% GROWTH	0%	-9%	8%	-1%	0%	-9%	0%	-9%	0%	-9%	0%	-9%	3%	-6%
1983	650	362	130	72	30	17	30	17	26	14	7.5	4.2	8.3	4.6
% GROWTH	0%	-14%	0%	-14%	0%	-14%	0%	-14%	0%	-14%	0%	-14%	9%	-6%
1984	650	329	150	76	30	15	30	15	26	13	7.5	3.8	9.8	5.0
% GROWTH	0%	-9%	15%	5%	0%	-9%	0%	-9%	0%	-9%	0%	-9%	18%	7%
1985	650	291	225	101	30	13	55.3	25	26	12	18.2	8.1	11	4.9
% GROWTH	0%	-12%	50%	33%	0%	-12%	84%	63%	0%	-12%	143%	114%	12%	-1%
1986	650	248	225	86	30	11	55.3	21	26	10	18.2	6.9	15.4	5.9
% GROWTH	0%	-15%	0%	-15%	0%	-15%	0%	-15%	0%	-15%	0%	-15%	40%	19%
1987	650	218	275	92	50	17	61.7	21	26	9	29.3	9.8	16.4	5.5
% GROWTH	0%	-12%	22%	8%	67%	47%	12%	-2%	0%	-12%	61%	42%	6%	-6%
1988	650	160	375	92	50	12	61.7	15	26	6	29.3	7.2	---	---
% GROWTH	0%	-27%	36%	0%	0%	-27%	0%	-27%	0%	-27%	0%	-27%	---	---
1989	650	121	375	70	70	13	78.3	15	26	5	35	6.5	---	---
% GROWTH	0%	-25%	0%	-25%	40%	6%	27%	-4%	0%	-25%	19%	-10%	---	---
AVERAGE GROWTH (%)	0%	-14%	17%	1%	12%	-4%	13%	-3%	2%	-12%	20%	4%	8%	-4%

NOTE : FIGURES DO NOT ADD UP DUE TO ROUNDING OFF

SOURCES: 1) EGPC [29], FOR PRICES OF OIL PRODUCTS
2) EEA [25], FOR ELECTRICITY PRICES
3) CAPMAS [12], FOR PRICE DEFLATORS (WPI)

TABLE (3.4)

INDEX FOR NOMINAL & REAL PRICES
OF ENERGY PRODUCTS IN EGYPT
1978 - 1989
(1978 = 100)

PRODUCT	LPG		GASOLINE		KEROSENE		GAS OIL		DIESEL		FUEL OIL		ELECTRICITY	
YEAR	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL	NOM	REAL
1978	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1979	100	87	121	106	120	105	120	105	124	108	100	87	86	75
1980	100	76	135	103	120	92	120	92	124	95	100	76	87	67
1981	100	71	169	119	120	85	120	85	124	87	100	71	86	61
1982	100	65	183	118	120	78	120	78	124	80	100	65	88	57
1983	100	56	183	102	120	67	120	67	124	69	100	56	97	54
1984	100	51	211	107	120	61	120	61	124	63	100	51	114	58
1985	100	45	317	142	120	54	221	99	124	55	243	108	128	57
1986	100	38	317	121	120	46	221	84	124	47	243	93	179	68
1987	100	34	387	130	200	67	247	83	124	42	391	47	191	64
1988	100	25	528	130	200	49	247	61	124	30	391	96	---	---
1989	100	19	528	98	280	52	313	58	124	23	467	87	---	---

SOURCE : CALCULATED FROM TABLE (3.3)

3.1. Subsidies in the oil sector:

There are two kinds of subsidies operating in the system of oil products price controls in Egypt; that is, financial subsidies and economic implicit subsidies.

3.1.1. Financial subsidies arise when some energy consumers in Egypt are supplied with oil products below their actual costs of production. This kind of subsidy can be calculated through the difference between the sale prices of oil products and their real costs of production. Unfortunately, the only study available to date is that of the Pearce-Whitman-Peida Consortium in 1981 [62], where it was shown that the financial subsidy in 1980 amounted to US$ 495 million while the net subsidy[6] was US$ 222 million. Financial direct subsidies are real costs to the Egyptian economy since they represent funds that could be used elsewhere in the economy.

3.1.2. Economic implicit subsidies whereby domestic prices are below border prices for exportable oil products, or below the import price for non-exported products such as LPG. This kind of subsidy reached quite a dramatic value in 1980 when international oil prices were at their peak. For

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[6]There are some oil products, however, such as gasoline, being sold at prices higher than their actual costs of production and thus, presenting negative financial subsidies (i.e., profits).

example, the implicit subsidy had reached 96% for Naphtha (i.e., sold at 4% of its border price), 94% for fuel oil (i.e., sold at 6% of its border price) [29]. Nonetheless, a single oil product, namely gasoline supreme (high-octane), is sold at 103% of its international price in 1983 (i.e., representing an implicit subsidy of -3% of its international price) [29].

In terms of the value of the economic implicit subsidy, however, Egyptian General Petroleum Corporation (EGPC) Annual Reports [29] as well as Table (3.1) indicate that the total economic subsidy for the major oil products consumed in Egypt has increased from L.E. 1433 million in 1980 to reach a peak of L.E. 1734 million in 1984/85, representing an increase of 21% during that period. However, as Table (3.1) shows, this value has declined to L.E. 668 million in 1986/87. Thus, its share in total implicit subsidy in Egypt has dropped from around 45% in 1982/83 to 28% in 1986/87. In real terms, during the period 1982/83 - 1986/87, the implicit subsidy on oil products has declined by over 77% as indicated by Table (3.1).

The decline in oil subsidies in both nominal and real terms, has been directly attributable to the declining trend in the international prices of oil in the early eighties. In fact, this is substantiated by the argument presented in the previous section which asserted that domestic prices of oil products were declining significantly in real terms in addition to the surge in their consumption throughout that period. In brief, it was not the government's intention to reduce oil subsidies as much as it was the falling international price of oil that was responsible for the reduced subsidy.

3.2. Subsidy structure in the electricity sector:

Subsidies on electricity in Egypt have climbed from L.E. 230 million in 1982/83 to L.E. 361 million in 1986/87 representing a nominal growth of 57% as Table (3.1) shows. Nonetheless, the same Table indicates that these subsidies have declined by only 5% during the same period in real terms. Its share in the total subsidy has doubled from around 8% in 1982/83 to 15% in 1986/87.[7] However, a point worth-noting is that the electricity sector is a net recipient of implicit subsidies in the sense that it purchases its fuel requirements from the oil sector at highly subsidized prices. Therefore, while the electricity sector grants implicit subsidies to other sectors of the Egyptian economy, the bulk of the burden is shouldered by the oil sector. Hence, the figures for the electricity subsidies only represent a single dimension of the subsidy which ought to be accounted for in the above figures though they have been included in the oil subsidies. In this sense, the figures for the electricity subsidies have been calculated as the difference between

[7] In fact, all electricity subsidies are implicit.

marginal costs of supply and their sale prices.[8] However, as the case of subsidizing fossil fuels for the electricity sector has persisted for a long time, there has been an increased reliance on this particular type of electricity generation. In fact, the electricity authority in Egypt has shown less enthusiasm to develop alternative sources for electricity generation as long as subsidy on fossil fuels existed. Subsequently, as the demand for electricity increased due to low subsidized prices, more pressures were placed on indigenous oil resources especially these of fuel oil, gas oil, and natural gas which are all used in thermal electricity generation. The end result is less foreign exchange earnings brought about from the reduced volume of oil exports. In addition, this subsidy represents a cost in the government budget which aggravates the deficit.

By examining Tables (3.5) and (3.6), one can clearly notice that industry dominated the electricity subsidy by receiving more than 50% or L.E. 120 million in 1982/83, which increased by over 14% to reach around L.E. 138 million in 1986/87 representing a decline in its share to 38%. In real terms, however, Table (3.5) as well as Figure (3.1) indicate that it has declined by 31% during the same period.

The same Tables show an opposite trend for the

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[8]However, the marginal cost calculations are based on subsidized domestic prices of fossil fuels used in electricity generation. In addition, shadow prices were not used in the adjustment for the price distortions present in the Egyptian economy. Nonetheless, these marginal costs figures give some indication on the levels of costs vis-a-vis subsidies in electricity.

TABLE (3.5)

ELECTRICITY SUBSIDIES IN EGYPT BY SECTOR
1982/83 - 1986/87
(IN CURRENT & 1982/83 000's L.E.)

YEAR / SECTOR	1982/83	1983/84		1984/85		1985/86		1986/87		PERIOD GROWTH	
	CURRENT	CURRENT	REAL	CURRENT	REAL	CURRENT	REAL	CURRENT	REAL	CURRENT	REAL
INDUSTRY	120941	123329	111938	112923	90537	125445	85757	137866	82927	14%	-31%
AGRICULTURE	7156	7649	6943	8751	7016	12419	8490	10771	6479	51%	-9%
RESIDENTIAL	71399	98081	89022	112886	90508	154266	105460	184117	110748	158%	55%
GOVERNMENT	6951	6856	6223	6921	5549	4957	3389	2557	1538	-63%	-78%
UTILITIES	19261	4143	3760	16812	13479	17418	11907	15370	9245	-20%	-52%
OTHERS	4076	4418	4010	5133	4115	6577	4496	10413	6263	155%	54%
TOTAL	229784	244476	221895	263426	211205	321082	219499	361094	217201	57%	-5%

SOURCES: 1) CURRENT VALUES COMPILED FROM TABLE (3.12)
2) CAPMAS [12], FOR PRICE DEFLATORS

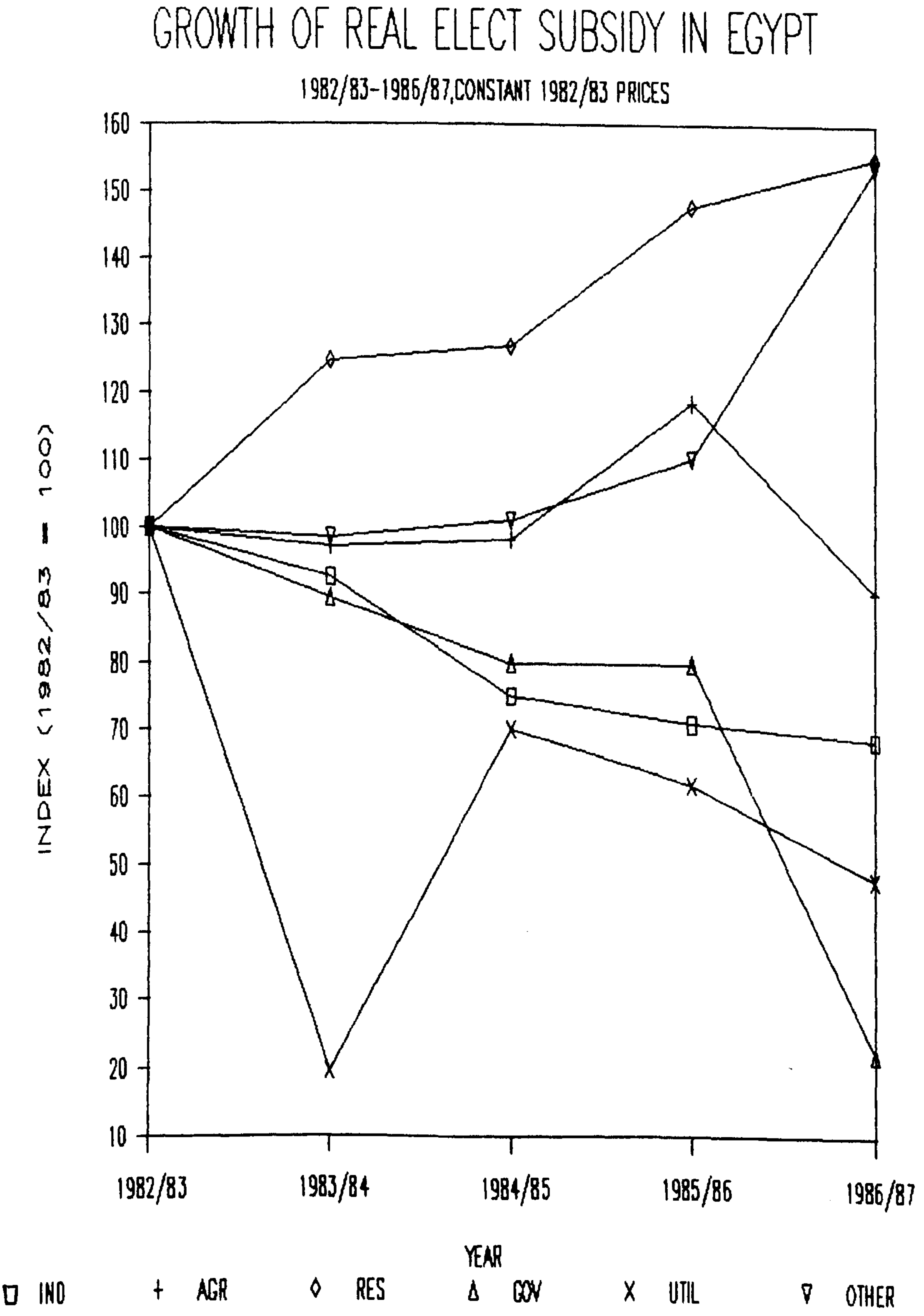
TABLE (3.6)

SECTORAL SHARES IN ELECTRICITY SUBSIDY
IN EGYPT
1982/83 - 1986/87

YEAR / SECTOR	1982/83	1983/84	1984/85	1985/86	1986/87
INDUSTRY	53%	54%	43%	39%	38%
AGRICULTURE	3%	3%	3%	4%	3%
RESIDENTIAL	31%	43%	43%	48%	51%
GOVERNMENT	3%	3%	3%	2%	1%
UTILITIES	8%	2%	6%	5%	4%
OTHERS	2%	2%	2%	2%	3%
TOTAL	100%	100%	100%	100%	100%

SOURCE : CALCULATED FROM TABLE (3.5)

Figure (3.1)


GROWTH OF REAL ELECT SUBSIDY IN EGYPT
1982/83-1986/87,CONSTANT 1982/83 PRICES
INDEX (1982/83 = 100)
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
1982/83
1983/84
1984/85
1985/86
1986/87
YEAR
IND
AGR
RES
GOV
UTIL
OTHER

residential sector where its subsidy has increased by 158% over the period 1982/83 to 1986/87, from 71 million L.E. to 184 million L.E., which is by far the greatest increase among all the other sectors. In real terms, the residential sector has exhibited a growth of 55% during the same period as indicated by Table (3.5) and Figure (3.1). With regard to its relative share, this sector has surged from a share of 31% in total electricity subsidy in 1982/83 to 51% in 1986/87 and thus, receiving the lion's share [Table (3.6)].

A more dis-aggregated analysis of the electricity subsidies is given in Tables (3.7) to (3.11) where the figures for the sales revenues, costs, and subsidies at the various voltage levels and by type of user are presented for the period 1982/83 to 1986/87.

In the discussion to follow, these two sectors will be discussed in more detail in an attempt to highlight the magnitude of subsidies and their development in each sector.

3.2.1. Industrial subsidy:

By examining Table (3.12) where electricity subsidies are dis-aggregated at the user level, implicit subsidies for industry at Ultra High Voltage (UHV) level has increased from L.E. 36 million in 1982/83 to L.E. 60 million in 1986/87, an increase of 65%. In terms of shares, this represents 16% of the total electricity subsidy in Egypt in 1982/83, increasing to 17% in 1986/87.

TABLE (3.7)

ELECTRICITY SUBSIDIES IN EGYPT
BY TYPE OF USER & VOLTAGE LEVEL
1982/83
(MKWH & 000's L.E.)

	CONS MKWH	SALES REV 000s L.E.	M. COSTS 000s L.E.	SUBSIDY 000s L.E.
ULTRA HIGH VOLTAGE				
KIMA FERTILISER	1449	6623	18698	12075
ALUMINIUM CO	2485	9527	32050	22523
SOMED PIPELINE	218	1106	2813	1707
ASSIUT CEMENT	---	---	---	----
OTHERS	---	---	---	----
SUB-TOTAL UHV	4152	17256	53561	36305
HIGH VOLTAGE				
INDUSTRY	736	4544	10959	6415
CEMENT	70	454	1042	588
AMERIA TEXTILE	0.5	31	8	(23)
MIRATEX CO	---	---	---	---
AGRICULTURE	504	3465	7513	4048
GOVERNMENT	30	195	445	250
SUB-TOTAL HV	1340.5	8689	19967	11278
MEDIUM VOLTAGE				
SUEZ CEMENT CO	6	2289	156	(133)
SALHEIA AGRI CO	57	1248	1247	(1)
OTHERS	--	---	---	---
SUB-TOTAL MV	63	3537	1403	(134)
DIST CO's (MV & LV)				
INDUSTRY	5316	65214	143003	77789
RESIDENTIAL	5484	99141	170540	71399
AGRICULTURAL	336	4926	8035	3109
UTILITIES	1819	27138	46399	19261
GOVERNMENT	697	14996	21697	6701
OTHER	372	3352	7428	4076
SUB-TOTAL DIST CO's	14024	214767	397102	182335
GRAND TOTAL	19580	244249	472033	229784

SOURCES : 1) CAPMAS STATISTICAL YEARBOOK [13]
2) EEA ANNUAL REPORT [25]

TABLE (3.8)

ELECTRICITY SUBSIDIES IN EGYPT
BY TYPE OF USER & VOLTAGE LEVEL
1983/84
(MKWH & 000's L.E.)

	CONS MKWH	SALES REV 000s L.E.	M. COSTS 000s L.E.	SUBSIDY 000's L.E
ULTRA HIGH VOLTAGE				
KIMA FERTILISER	1392	7974	19213	11239
ALUMINIUM CO	3134	16146	43241	27095
SOMED PIPELINE	248	1570	3425	1855
ASSIUT CEMENT	0.1	1	1	---
OTHERS	---	---	---	---
SUB-TOTAL UHV	4774	25691	65880	40189
HIGH VOLTAGE				
INDUSTRY	778	5820	12365	6545
CEMENT	64	746	1022	276
AMERIA TEXTILE	37	681	587	(94)
MIRATEX CO	1	13	18	5
AGRICULTURE	588	5177	8742	3565
GOVERNMENT	32	265	511	246
SUB-TOTAL HV	1500	12702	23245	10543
MEDIUM VOLTAGE				
SUEZ CEMENT CO	32	1599	884	(715)
SALHEIA AGR CO	40	941	939	(2)
OTHERS	--	---	896	896
SUB-TOTAL MV	72	2540	2719	179
DIST CO's (MV & LV)				
INDUSTRY	5734	88490	165613	77123
RESIDENTIAL	6816	130949	229030	98081
AGRICULTURAL	379	6496	9686	3190
UTILITIES	1747	31019	35162	4143
GOVERNMENT	783	19676	26286	6610
OTHER	421	4672	9090	4418
SUB-TOTAL DIST CO's	15880	281302	474867	193565
GRAND TOTAL	22092	322235	566711	244476

SOURCES : 1) CAPMAS STATISTICAL YEARBOOK [13]
2) EEA ANNUAL REPORT [25]

TABLE (3.9)

ELECTRICITY SUBSIDIES IN EGYPT
BY TYPE OF USER & VOLTAGE LEVEL
1984/85
(MKWH & 000's L.E.)

	CONS MKWH	SALES REV 000s L.E.	M. COSTS 000s L.E.	SUBSIDY 000s L.E.
ULTRA HIGH VOLTAGE				
KIMA FERTILISER	1370	8703	20134	11431
ALUMINIUM CO	3045	17076	44754	27678
SOMED PIPELINE	207	1450	3044	1594
ASSIUT CEMENT	3	49	37	(12)
OTHERS	--	--	--	---
SUB-TOTAL UHV	4625	27278	67969	40691
HIGH VOLTAGE				
INDUSTRY	806	7101	13621	6520
CEMENT	67	1467	1179	(288)
AMERIA TEXTILE	84	1528	1424	(104)
MIRATEX CO	59	796	992	196
AGRICULTURE	597	5108	10096	4988
GOVERNMENT	29	264	498	234
SUB-TOTAL HV	1642	16264	27810	11546
MEDIUM VOLTAGE				
SUEZ CEMENT CO	70	3899	2030	(1869)
SALHEIA AGRI CO	86	652	1196	544
OTHERS	--	687	963	276
SUB-TOTAL MV	156	5238	4189	(1049)
DIST CO's (MV & LV)				
INDUSTRY	6080	117670	185447	67777
RESIDENTIAL	7794	161908	274794	112886
AGRICULTURAL	468	8594	11537	2943
UTILITIES	1761	34877	51689	16812
GOVERNMENT	789	22601	29288	6687
OTHER	490	6374	11507	5133
SUB-TOTAL DIST CO's	17382	352024	564262	212238
GRAND TOTAL	23805	400804	664230	263426

SOURCES : 1) CAPMAS STATISTICAL YEARBOOK [13]
2) EEA ANNUAL REPORT [25]

TABLE (3.10)

ELECTRICITY SUBSIDIES IN EGYPT
BY TYPE OF USER & VOLTAGE LEVEL
1985/86
(MKWH & 000's L.E.)

	CONS MKWH	SALES REV 000s L.E.	M. COSTS 000s L.E.	SUBSIDY 000s L.E.
ULTRA HIGH VOLTAGE				
KIMA FERTILISER	1604	13952	23294	9342
ALUMINIUM CO	3230	23333	61213	37880
SOMED PIPELINE	204	1961	4126	2165
ASSIUT CEMENT	58	2100	1179	(921)
OTHERS	--	307	262	(45)
SUB-TOTAL UHV	5096	41653	90074	48421
HIGH VOLTAGE				
INDUSTRY	890	11412	20218	8806
CEMENT	140	4391	3179	(1212)
AMERIA TEXTILE	75	1773	1703	(70)
MIRATEX CO	62	1338	1396	58
AGRICULTURE	643	7523	14596	7073
GOVERNMENT	19	200	425	225
SUB-TOTAL HV	1829	26637	41517	14880
MEDIUM VOLTAGE				
SUEZ CEMENT CO	67	3011	2418	(593)
SALHEIA AGRI CO	93	1032	1630	598
OTHERS	--	1105	1323	218
SUB-TOTAL MV	160	5148	5371	223
DIST CO's (MV & LV)				
INDUSTRY	6631	180647	250682	70035
RESIDENTIAL	8888	228939	383205	154266
AGRICULTURAL	453	13080	17610	4530
UTILITIES	1976	53467	70885	17418
GOVERNMENT	852	32901	37633	4732
OTHER	506	8119	14696	6577
SUB-TOTAL DIST CO's	19306	517153	774711	257558
GRAND TOTAL	26391	590591	911673	321082

SOURCES : 1) CAPMAS STATISTICAL YEARBOOK [13]
2) EEA ANNUAL REPORT [25]

TABLE (3.11)

ELECTRICITY SUBSIDIES IN EGYPT
BY TYPE OF USER & VOLTAGE LEVEL
1986/87
(MKWH & 000's L.E.)

	CONS MKWH	SALES REV 000s L.E.	M. COSTS 000s L.E.	SUBSIDY 000s L.E.
ULTRA HIGH VOLTAGE				
KIMA FERTILISER	1564	14524	33150	18626
ALUMINIUM CO	3045	25170	64552	39382
SOMED PIPELINE	272	2755	5768	3013
ASSIUT CEMENT	119	2769	2516	(253)
OTHERS	---	8618	7873	(745)
SUB-TOTAL UHV	5000	53836	113859	60023
HIGH VOLTAGE				
INDUSTRY	889	12164	21181	9017
CEMENT	174	5330	4137	(1193)
AMERIA TEXTILE	58	1725	1377	(348)
MIRATEX CO	74	1726	1741	15
AGRICULTURE	663	8332	15684	7352
GOVERNMENT	---	----	-----	----
SUB-TOTAL HV	1858	29277	44120	14843
MEDIUM VOLTAGE				
SUEZ CEMENT CO	97	3697	3671	(26)
SALHEIA AGRI CO	91	1086	1714	628
OTHERS	--	1143	1358	215
SUB-TOTAL MV	188	5926	6743	817
DIST CO's (MV & LV)				
INDUSTRY	7227	220493	290871	70378
RESIDENTIAL	9755	261979	446096	184117
AGRICULTURAL	413	15707	18283	2576
UTILITIES	2192	64878	80248	15370
GOVERNMENT	940	40351	42908	2557
OTHER	564	9994	20407	10413
SUB-TOTAL DIST CO's	21091	613402	898813	285411
GRAND TOTAL	28137	702441	1063535	361094

SOURCES : 1) CAPMAS STATISTICAL YEARBOOK [13]
2) EEA ANNUAL REPORT [25]

TABLE (3.12)

ELECTRICITY SUBSIDY IN EGYPT
BY VOLTAGE LEVEL
1982/83 - 1986/87
(IN 000's L.E.)

	1982/83		1983/84		1984/85		1985/86		1986/87	
ULTRA HIGH VOLTAGE	000's L.E	SHARE	000's L.E	SHARE	000's L.E	SHARE	000's L.E	SHARE	000's L.E	SHARE
KIMA FERTILISER	12075	5.3%	11239	4.6%	11431	4.3%	9342	2.9%	18626	5.2%
ALUMINIUM CO	22523	9.8%	27095	11.1%	27678	10.5%	37880	11.8%	39382	10.9%
SOMED PIPELINE	1707	0.7%	1855	0.8%	1594	0.6%	2165	0.7%	3013	0.8%
ASSIUT CEMENT	----	---	----	---	(12)	---	(921)	---	(253)	---
OTHERS	----	---	----	---	----	---	(45)	---	(745)	---
SUB-TOTAL UHV	36305	15.8%	40189	16.4%	40691	15.4%	48421	15.1%	60023	16.6%
HIGH VOLTAGE										
INDUSTRY	6415	2.8%	6545	2.7%	6520	2.5%	8806	2.7%	9017	2.5%
CEMENT	588	0.3%	276	0.1%	(288)	---	(1212)	---	(1193)	---
AMERIA TEXTILE	(23)	---	(94)	---	(104)	---	(70)	---	(348)	---
MIRATEX CO	---	---	5	0.0%	196	0.1%	58	0.0%	15	0.0%
AGRICULTURE	4048	1.8%	3565	1.5%	4988	1.9%	7073	2.2%	7352	2.0%
GOVERNMENT	250	0.1%	246	0.1%	234	0.1%	225	0.1%	----	---
SUB-TOTAL HV	11255	4.9%	10543	4.3%	11546	4.4%	14880	4.6%	14843	4.1%
MEDIUM VOLTAGE										
SUEZ CEMENT CO	(133)	---	(715)	---	(1869)	---	(593)	---	(26)	---
SALHEIA AGRI CO	(1)	---	(2)	---	544	0.2%	598	0.2%	628	0.2%
OTHERS	--	---	896	0.4%	276	0.1%	218	0.1%	215	0.1%
SUB-TOTAL MV	(134)	---	179	0.1%	(1049)	---	223	0.1%	817	0.2%
DIST CO's (MV & LV)										
INDUSTRY	77789	33.9%	77123	31.5%	67777	25.7%	70035	21.8%	70378	19.5%
RESIDENTIAL	71399	31.1%	98081	40.1%	112886	42.9%	154266	48.0%	184117	51.0%
AGRICULTURAL	3109	1.4%	3190	1.3%	2943	1.1%	4530	1.4%	2576	0.7%
UTILITIES	19261	8.4%	4143	1.7%	16812	6.4%	17418	5.4%	15370	4.3%
GOVERNMENT	6701	2.9%	6610	2.7%	6687	2.5%	4732	1.5%	2557	0.7%
OTHER	4076	1.8%	4418	1.8%	5133	1.9%	6577	2.0%	10413	2.9%
SUB-TOTAL DIST CO's	182335	79.4%	193565	79.2%	212238	80.6%	257558	80.2%	285411	79.0%
GRAND TOTAL	229761	100%	244476	100%	263426	100%	321082	100%	361094	100%

SOURCE : COMPILED FROM TABLES (3.7) TO (3.11)

The most notable observation one can make is the large amount of subsidy allocated to two industrial firms at the UHV level or indeed at any other voltage level; namely, the Aluminium Complex at Naga'a Hammadi and the Kima Fertilizer Company. That is, as indicated by Table (3.12), the electricity subsidy in the Aluminum Complex has increased from L.E. 22.5 million in 1982/83 to L.E. 39.4 million in 1986/87, a growth of 75% in nominal terms while that of the Kima Company has also increased from L.E. 12.1 million to L.E. 18.6 million during the same period, realizing a growth of around 60%. All of the previous argument tends to point-out an alarming fact whereby a single industrial firm accounts for more than 10% of all electricity subsidy in Egypt. In fact, it would be of considerable importance to conduct further investigation on the economic efficiency and competitiveness of this specific firm in Egypt. However, this study - though important - would be beyond the scope of this thesis.

Table (3.12) does not indicate any increase in industry's share in electricity subsidy at the High Voltage (HV) level, considering the profits realized on some electricity sales to certain industrial firms as indicated by Tables (3.7) - (3.11).

At the medium and low voltage levels (MV & LV), industry's share has declined from 34% in 1982/83 to only around 20% in 1986/87. That is, in nominal terms, it has been reduced from L.E. 77.8 million to L.E. 70.4 million, a decline of almost 10% during the same period as indicated by Table (3.12).

Due to the differences in consumption between various industries, any analysis of the total subsidy figures without consideration of subsidy per KWH falls short of providing an exact and thorough comparison between industries. Therefore, we have calculated the electricity subsidy per KWH at various voltage levels and presented them in Table (3.13). The Table indicates that the Aluminium Complex has once again received subsidy per KWH which is by far the largest among all other users at the UHV, HV, and MV throughout the period 1982/83 to 1986/87. In nominal terms, it has jumped from 9.1 mills/KWH in 1982/83 to 12.9 mills/KWH in 1986/87, an increase of 42%. With regard to the Kima Fertilizer, the subsidy /KWH has increased from 8.3 mills/KWH in 1982/83 to 11.9 mills/KWH, an increase of 31%.

The same Table shows that industry supplied by the distribution companies at the MV and LV levels has received a subsidy /KWH of 14.6 mills in 1982/83, which exceeded that in any other sector even at other voltage levels. However, it gradually declined in successive years to reach only 9.8 mills/KWH in 1986/87, representing a decline of 33%. In real terms, this represents a decline of 60% during the same period, as indicated by Table (3.14) in addition to Figure (3.2).

TABLE (3.13)

PRICE, MARGINAL COST & SUBSIDY PER UNIT OF ELECTRICITY
SUPPLIED IN EGYPT, 1982/83 - 1986/87
(MILLS/KWH)

	1982/83			1983/84			1984/85			1985/86			1986/87		
	UNIT PRICE M/KWH	UNIT COST M/KWH	UNIT SUBS M/KWH	UNIT PRICE M/KWH	UNIT COST M/KWH	UNIT SUBS M/KWH	UNIT PRICE M/KWH	UNIT COST M/KWH	UNIT SUBS M/KWH	UNIT PRICE M/KWH	UNIT COST M/KWH	UNIT SUBS M/KWH	UNIT PRICE M/KWH	UNIT COST M/KWH	UNIT SUBS M/KWH
KIMA	4.6	12.9	8.3	5.7	13.8	8.1	6.4	14.7	8.3	8.7	14.5	5.8	9.3	21.2	11.9
ALUM	3.8	12.9	9.1	5.2	13.8	8.6	5.6	14.7	9.1	7.2	19.0	11.8	8.3	21.2	12.9
SOMED	5.1	12.9	7.8	6.3	13.8	7.5	7.0	14.7	7.7	9.6	20.3	10.7	10.1	21.2	11.1
CEMENT	---	---	---	10.0	10.0	0.0	16.3	12.3	(4.0)	36.2	20.3	(15.9)	23.3	21.2	(2.1)
AVERAGE UHV	4.5	12.9	8.4	6.8	12.9	8.1	8.8	14.1	5.3	15.4	18.5	3.1	12.8	21.2	8.5
INDUST	6.2	14.9	8.7	7.5	15.9	8.4	8.8	16.9	8.1	12.8	22.7	9.9	13.7	23.8	10.1
CEMENT	6.5	14.9	8.4	11.7	15.9	4.2	21.9	17.6	(4.3)	31.4	22.7	(8.7)	30.6	23.8	(6.8)
AMBREIA	62.0	14.9	(46.0)	18.4	15.9	(2.5)	18.2	17.0	(1.2)	23.6	22.7	(0.9)	29.7	23.8	(5.9)
MIRATEX	---	---	---	13.0	18.0	5.0	13.5	16.8	3.3	21.6	22.7	1.1	23.3	23.8	0.5
AGRICUL	6.9	14.9	8.0	8.8	14.9	6.1	8.6	16.9	8.3	11.7	22.7	11.0	12.6	23.8	1.2
GOVER'T	6.5	14.9	8.4	8.3	15.9	7.6	9.1	17.2	8.1	10.5	22.7	12.2	0.0	0.0	0.0
AVERAGE HV	17.6	14.9	(2.5)	11.3	16.1	4.8	13.4	17.1	3.7	18.6	22.7	4.8	22.0	23.8	(0.1)
CEMENT	48.2	26.0	(22.2)	50.0	27.6	(22.4)	55.7	29.0	(26.7)	44.9	36.1	(8.8)	38.1	37.9	(0.2)
SALHEIA	21.9	21.9	0.0	23.5	23.5	0.0	7.6	13.9	6.3	11.1	17.5	6.4	11.9	18.8	6.9
AVERAGE MV	35.1	24.0	(11.1)	36.8	25.6	(11.2)	31.7	21.5	(10.2)	28.0	26.8	(1.2)	25.0	28.4	3.4
INDUST	12.3	26.9	14.6	15.4	28.9	13.5	19.4	30.5	11.1	27.2	37.8	10.6	30.5	40.3	9.8
RESID'L	18.1	31.1	13.0	19.2	33.6	14.4	20.8	35.3	14.5	25.8	43.1	17.3	26.9	45.7	18.8
AGRICUL	14.7	23.9	9.2	17.1	25.6	8.5	18.4	24.7	6.3	28.9	38.9	10.0	38.0	44.3	6.3
UTILIT	14.9	25.5	10.6	17.8	20.1	2.3	19.8	29.4	9.6	27.1	35.9	8.8	29.6	36.6	7.0
GOVER'T	21.5	31.1	9.6	25.1	33.6	8.5	28.7	37.1	8.4	38.6	44.2	5.6	42.9	45.7	2.8
OTHER	9.0	20.0	11.0	11.1	21.6	10.5	13.0	23.5	10.5	16.1	29.0	12.9	17.7	36.2	18.5
AVERAGE DIS COs	15.1	26.4	11.3	17.6	27.2	9.6	20.0	30.1	10.1	27.3	38.2	10.9	30.9	41.5	10.5
OVERALL AVERAGE	18.1	19.5	1.5	18.1	20.4	2.8	18.5	20.7	2.2	22.3	26.5	4.4	22.7	28.7	4.7

SOURCE: CALCULATED FROM TABLES (3.7) TO (3.11)

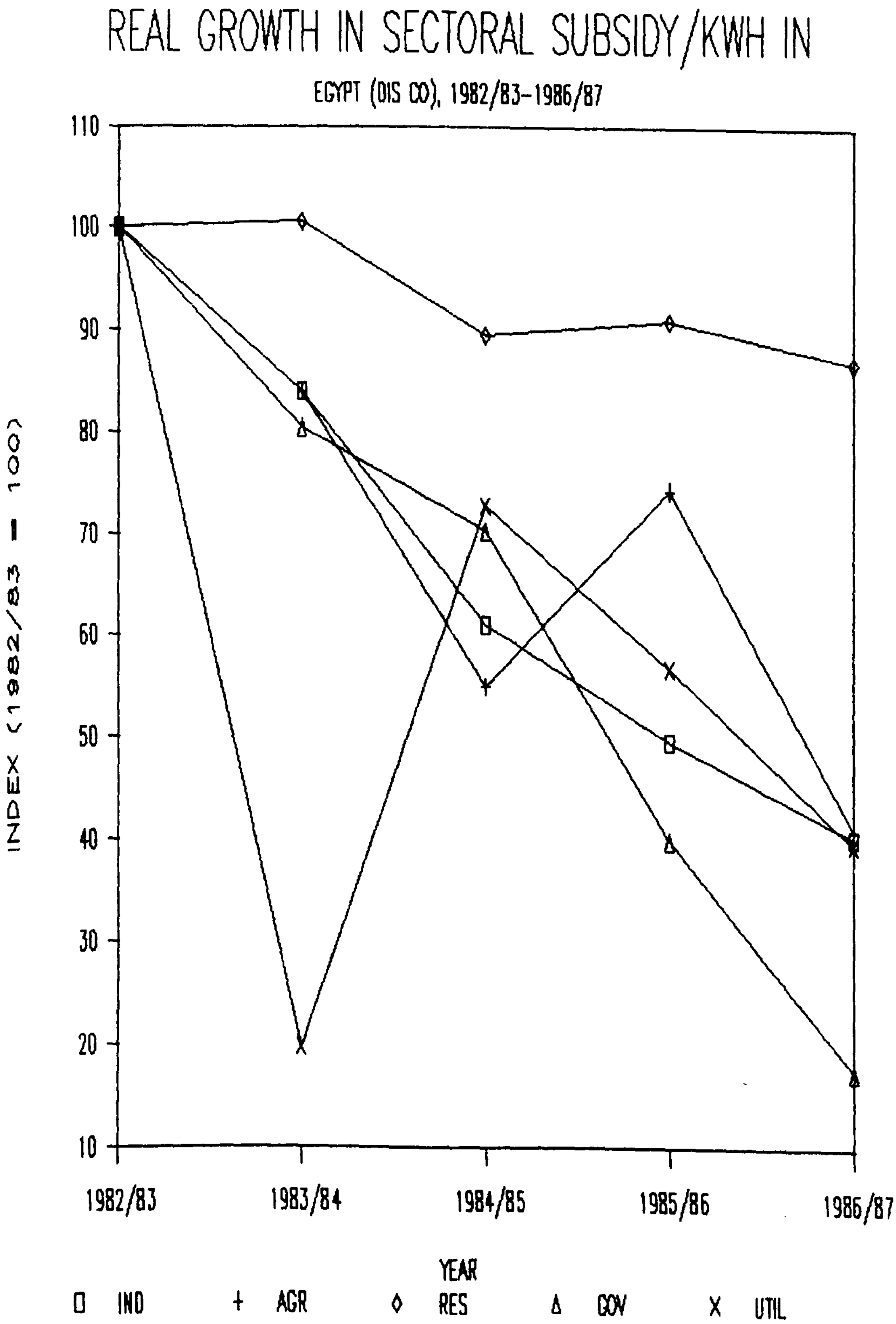
TABLE (3.14)

DEVELOPMENT OF ELECTRICITY SUBSIDY/KWH BY SECTOR
IN EGYPT (DIST CO's)
1982/83 - 1986/87
(NOMINAL & 1982/83 MILLS/KWH)

YEAR / SECTOR	1982/83	1983/84		1984/85		1985/86		1986/87		PERIOD GROWTH	
	NOMINAL	NOMIN	REAL	NOMIN	REAL	NOMIN	REAL	NOMIN	REAL	NOMIN	REAL
INDUSTRY	14.6	13.5	12.3	11.1	8.9	10.6	7.2	9.8	5.9	-33%	-60%
RESIDENTIAL	13.0	14.4	13.1	14.5	11.6	17.3	11.8	18.8	11.3	45%	-13%
AGRICULTURE	9.2	8.5	7.7	6.3	5.1	10.0	6.8	6.3	3.8	-32%	-59%
UTILITITIES	10.6	2.3	2.1	9.6	7.7	8.8	6.0	7.0	4.2	-34%	-60%
GOVERNMENT	9.6	8.5	7.7	8.4	6.7	5.6	3.8	2.8	1.7	-71%	-82%
OTHERS	11.0	10.5	9.5	10.5	8.4	12.9	8.8	18.5	11.1	68%	1%

SOURCES : 1) NOMINAL FIGURES COMPILED FROM TABLE (3.13)
2) PRICE DEFLATORS FROM CAPMAS ANNUAL REPORT [12]

Figure (3.2)


REAL GROWTH IN SECTORAL SUBSIDY/KWH IN
EGYPT (DIS CO), 1982/83-1986/87
INDEX (1982/83 = 100)
110
100
90
80
70
60
50
40
30
20
10
1982/83
1983/84
1984/85
1985/86
1986/87
YEAR
IND
AGR
RES
GOV
UTIL

3.2.2. Residential subsidy:

The foregoing discussion suggested the industrial sector has dominated the structure of electricity subsidy in Egypt; for example, it was shown that it had received more than half of the total electricity subsidy granted in 1982/83. We also indicated a declining trend in its share by 1986/87 whereby the share of the residential subsidy was simultaneously emerging to assume much greater importance.

In fact, the share of electricity subsidy granted to the residential sector in Egypt has surged from 31% in 1982/83 to 51% in 1986/87 to exceed those of the other sectors of the economy as indicated by Table (3.6). In nominal terms, Table (3.5) indicates that the value of the residential subsidy in 1982/83 was L.E. 71.4 million, leaping dramatically to L.E. 110.8 million in 1986/87; a substantial growth of 158% which surpassed any increase by other major sectors throughout that period. Table (3.5) also shows that this sector was able to achieve an increase in its electricity subsidy by over 55% in real terms during the same period; once again this growth rate has exceeded those of the other major sectors in real terms.

On analysing residential subsidies per KWH, Tables (3.13) and (3.14) indicate that they have increased from 13 mills/KWH in 1982/83 - coming second to industry - to 18.8 mills/KWH in 1986/87, which is by far the greatest amongst other sectors even those at other voltage levels. On adjusting for inflation, it appears that the residential sector was able to realize the least decline in contrast to all the other sectors supplied by the distribution companies. That is, residential subsidy /KWH has dropped by only 13% during the period 1982/83 - 1986/87 whereas those of government, industry, agriculture, and utilities, have declined by 82%, 60%, 59%, and 60% respectively throughout the same period as shown by Table (3.14) and Figure (3.2).

In fact, Table (3.13) clearly indicates that the electricity subsidy in the residential sector /KWH amounted to 71% of the price of a KWH supplied in this sector on average throughout the period 1982/83 -1986/87. This implies that the Egyptian government shoulders over 70% of the cost of a single unit of electricity supplied to residential customers who - regardless of their individual incomes - only have to pay 30% of the cost on average.

Indeed, very important implications emerge at this critical point, the most serious of which is that of consumer signals. Consumers of electricity do not get the correct cost signals through the system for their consumption. In such a situation, increased demand for electricity can be interpreted as a direct result of wasteful and extravagant consumption with little or no attempt for any rationalization or conservation measures.

With regard to subsidy per household, unfortunately, relevant data is unavailable to give an exact indication.

However, the unpublished household budget survey of 1981/82 [14] could be used with the 1982/83 data as a proxy for the appropriate ones. Though this procedure is not accurate, it nonetheless, gives an approximation to the correct analysis.

Thus, Table (3.15) indicates the average quantity of electricity consumed per both rural and urban households in each income group in 1981/82. The Table also presents the data for electricity subsidy per household[9] in abstract terms and as a percentage of average income per income group.

From the Table, one can make a few observations. First and foremost, average electricity consumption per urban household is greater than that of rural ones to the extent that it reaches almost three times in some income groups. Second, higher electricity consumption in urban households than those in rural households has - despite that average income in the former is higher than the latter -implied a bias of electricity subsidy towards urban households.

In fact, Table (3.15) indicates that urban electricity subsidy constitutes a greater proportion of average income than that of rural ones. In brief, it appears that the bulk of the residential electricity subsidy is exploited more intensively in urban households and the benefits of electricity subsidy are not being utilized in rural areas where incomes are lower and electricity consumption levels are also much less than in urban households. A point worth-

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[9]That is, using the value of subsidy /KWH in 1982/83 for the residential sector as given in Table (3.14)

TABLE (3.15)

ELECTRICITY SUBSIDY PER URBAN & RURAL HOUSEHOLD
& AS PERCENTAGE OF AVERAGE HH INCOME
IN EGYPT
1981/82

ANNUAL INCOME BANDS L.E.	TOTAL CONSUMPTION (KWH)		NUMBER OF HHs		CONSUMPTION/HH (KWH)		SUBSIDY / HH (MILLS)		ANNUAL HH INCOME (L.E.)		SUBS : HH INCOME (%)	
	URBAN	RURAL	URBAN	RURAL	URBAN	RURAL	URBAN	RURAL	URBAN	RURAL	URBAN	RURAL
-400	62209	26855	348	641	179	42	2324	545	272	252	0.9%	0.2%
400-	167643	100852	506	861	331	117	4307	1523	508	505	0.8%	0.3%
600-	269627	220625	917	1267	294	174	3822	2264	706	702	0.5%	0.3%
800-	654967	327467	1207	1449	543	226	7054	2938	902	897	0.8%	0.3%
1000-	759190	370259	1240	1270	612	292	7959	3790	1098	1099	0.7%	0.3%
1200-	820446	304441	1181	974	695	313	9031	4063	1297	1296	0.7%	0.3%
1400-	758562	208944	951	567	798	369	10369	4791	1497	1494	0.7%	0.3%
1600-	985077	238859	1118	618	881	387	11454	5025	1780	1774	0.6%	0.3%
2000-	926125	195147	998	454	928	430	12064	5588	2399	2404	0.5%	0.2%
3000-	307290	41500	275	79	1117	525	14526	6829	3465	3377	0.4%	0.2%
4000-	163500	15139	145	24	1266	631	16452	8200	4859	4917	0.3%	0.2%
6000-	110016	6703	69	13	1594	516	20728	6703	7928	8039	0.3%	0.1%

NOTE: SUBSIDY / HOUSEHOLD CALCULATED AT 13 MILLS/KWH COMPILED FROM TABLE (3.13)

SOURCE: COMPILED AND CALCULATED FROM AN UNPUBLISHED 1981/82 HOUSEHOLD BUDGET SURVEY ACQUIRED THROUGH PERSONAL COMMUNICATION WITH CAPMAS [13] noting is that during the period the survey was conducted (i.e., 1981/82) the rural electrification programme was not yet completed and therefore, there were many rural households not connected to the electricity service.

4. Subsidies and electricity prices:

The case for subsidization of electricity is said to rest on equity grounds. That is, many developing countries have set out to subsidize the cost of electricity mainly for the low-income groups in order to satisfy their basic needs of electricity use.

Three issues should be noted in this context. First, low-priced, lifeline rates may deviate markedly from economic efficiency criteria. Second, the amount of the subsidy that is to be made available through the lifeline rates must be carefully monitored so that either the revenue of the subsequent higher-priced blocks balances the losses incurred or a sufficiently high subsidy is paid by the government; otherwise, the financial viability of the supply organization will be jeopardized. Third and most important, with regard to the direct effects of electricity subsidies, it is not obvious that they would have equitable consequences. Benefits from subsidization, especially those other than lighting, are mostly received by the relatively better-off households in the rural areas.[10]

Indeed, the attempt to confine subsidies to the poorer segments of society through the implementation of lifeline rates is a laudable objective if it can be ensured that the target groups (rural and/or urban poor) are, in fact, getting the benefits of these subsidies and lower prices. Invariably, this equity objective is not met for a variety of reasons which need to be investigated thoroughly so that the benefits of low prices are available to those for whom they are intended. That is, if tariffs are lowered for consumption below a certain level (lifeline rate), richer households consuming electricity below this level will automatically benefit. This is a typical case in many developing countries where quite a percentage of the households (especially those in urban areas) represent a relatively wealthy segment of the population, and there is no good reason for pricing that portion of their electricity consumption which is in excess of the basic minimum at less than marginal cost. This is also the case for isolated rural areas where the bulk of the costs will be in the equipment and infrastructure. The principle of charging for fixed costs by a connection charge then leads to decreasing average tariffs by use and will be regressive, while rural electricity is likely to be significantly more expensive on average than urban electricity, again likely to be regressive. In other words, as the costs of wiring a house

[10] In fact, subsidization may also lead to benefits to other sections of the community as well, though indirectly via the increase in consumption and load factor.

for electricity connection are very high for the poor people (whose cash incomes are very low), they are not in a position to take advantage of domestic connection. For many of them, even a relatively small monthly charge (monthly increment) would be quite high, considering other basic necessities. As a result, only a small proportion of the households in rural areas of electrified villages have household connections. These are, invariably, better-off sections of the rural society where the beneficiaries are rich farmers and artisans who could afford to pay higher electricity prices while are, in fact, getting the benefits of low-priced electricity supplies intended for the poor.

On the other hand, for financial reasons, the electricity utility frequently has to ensure that high income urban areas - where the need for electricity is higher because of higher population density and higher electricity demand - receive a bigger share in electricity supply than those in rural areas - where less congested low income groups have much lower demand for electricity. Despite the fact that there may be political pressures for wider programmes of rural electrification, the electricity utility requires - due to its financial viability - that individuals willingness or ability to pay is given more weight in determining investment priorities than the external effects. Clearly, this may not be an economically efficient ordering of priorities, but due to financial constraints electricity authorities frequently find themselves in such a position. In fact, on the basis of cost considerations alone, the price of electricity may be expected to be higher in rural areas than in urban areas since marginal costs are usually higher for serving these areas due to the dispersed nature of demand. It is generally accepted, however, that prices should be below costs in the early years of electrification because costs are very high before demand has developed to a reasonable load factor. A more important consideration is that the provision of cheap electricity by subsidization is regarded as necessary to promote its use. Nonetheless, the losses on account of low tariffs for certain categories of consumers are partly made good by raising tariffs for other consumer groups (e.g., residential consumers). Such cross-subsidization results in the transfer of resources between different categories of consumers (e.g., agricultural consumers being subsidized by residential consumers in urban areas). Such redistribution of resources may not be equitable since agricultural consumers may be relatively better off than urban residential consumers. On the other hand, the inability of the electricity utility to earn adequate surpluses to meet their commitments can result in the requirements of the power sector being largely met from public taxation. This would lead to a transfer of resources from taxpayers to consumers of subsidized electricity.

However, despite the fact that the contribution of rural electrification to energy requirements in rural areas is still small in aggregate terms, it plays a crucial role in agricultural and industrial uses and in households. Nonetheless, the connection of a village to the electricity grid does not mean that its total population has access to it. In fact, the rural households that do have electricity are generally much more well off than others without electricity since the fixed costs of obtaining the connection are usually high.

It is necessary nonetheless for any developing country to consider policy measures which can reconcile the various objectives of electricity pricing; namely, meeting the basic needs of poor people, avoiding the mis-allocation of energy inputs, and raising adequate resources for investments. Some ideas regarding these issues include: (1) two- (multiple-) step tariff which equates the top step to marginal cost; (2) schemes of providing direct subsidies to target groups rather than a general subsidy should be evaluated; (3) public investments in the provision of electricity should be extended to include the provision of complementary inputs and finances so as to enable target consumers to avail themselves of the benefits; (4) subsidies may be given on the cost of equipment rather than on fuels.

In the following, we will discuss the four ideas mentioned above which attempt to reconcile the efficiency and equity objectives sought in the electricity tariffs of developing countries.

4.1. Two- (multiple-) step tariff:

It would seem that a two-step tariff which emphasizes allocational efficiency by equating the top step to marginal cost would best focus on the one aspect on which tariffs can have a significant impact. Within the same context, a tariff schedule with multiple-step or with blocks which are intended to increase approximately in proportion to the recorded income distribution of the country, are relatively common in developing countries but, while they may often be the best that can be achieved in a political sense, are not an entirely satisfactory solution. In chapter 4, we will demonstrate that while the current residential electricity tariff consists of ten blocks, the majority of the residential consumers lie within the first block which receives the bulk of the subsidy.

4.2. Direct subsidies for target groups:

With regard to subsidies, rather than providing a general subsidy, the governments may consider giving direct subsidies to target groups through special coupons. These coupons or electricity stamps could be used by the low-income groups of the population to pay for electricity bills or alternatively, it could be used to pay for staple food. In fact, such a scheme has been introduced in Sri Lanka [44] whereby apart from providing subsidized kerosene to all, the

Government of Sri Lanka simultaneously operates a kerosene stamp scheme under which roughly the poorer half of the population receive monthly coupons, which can be used to pay for kerosene or basic food products.

In principle this seems to be an attractive scheme since it removes the general subsidy and makes it available to target groups only; that is, changing its type from an open-ended to a more specific one. In fact, the potential advantages of this scheme are: (1) it would exclude the rich from receiving the subsidy in the case that the coupons are non-transferable; (2) as electricity prices would no longer be set below their economic costs, the incentives to use it inefficiently would be reduced. That is, there would be less wasteful consumption and more conservation measures being implemented simultaneously; (3) this would give the oil sector more freedom to set the prices of their products which are used in electricity generation (i.e., natural gas, fuel oil and gas oil) at their opportunity costs[11] and thus, increasing export revenues of oil products or reducing import bills in the case of a country being a net oil importer; (4) by replacing a subsidy in kind (cheap electricity) with an effective cash transfer, the welfare of poorer households would be increased to the extent that they would choose to spend this higher income on other goods upon which they

[11]This is true since the oil sector subsidizes the price of products sold to the electricity supply organization and hence shoulders a major part of the subsidies granted by the latter. This is the case in Egypt as has been mentioned previously.

placed a higher value; (5) the abolition of the electricity subsidy would most definitely result in a reduced consumption of electricity and thus, releasing resources to be utilized by other sectors of the economy.

Although this scheme seems very attractive to reconcile the objectives of equity and efficiency, it is expensive to administer. It may be therefore necessary to do a comprehensive review of such a stamp scheme, including its administrative costs and problems and the impact it is expected to have on consumption and real incomes of the poor portion of the population.

4.3. Extending the scope of public investments:

As mentioned above, although the objective of subsidized electricity was to help the poor people, those in the rural areas could not benefit from the rural electrification programmes since they could not afford the initial costs of internal wiring.

In this context, it is necessary to redefine and enlarge the scope of the rural electrification programme so as to include internal wiring of houses at the government's expense to enable the rural consumers to use electricity. Though such an inclusion would add to the costs of rural electrification schemes, it would provide benefits of better lighting to the consumers and result in a more equitable distribution of benefits from large investments in rural electrification infrastructure. However, the alternative to such a scheme would be to make the fixed connection charge a function of installed capacity, which, if made progressive, will avoid the equity-efficiency conflict.

4.4. Subsidies on the cost of equipment:

Since the cost of electricity is only part of the total costs of using electric power, whether for households or for business, then, it is more likely that the availability and reliability of equipment would be of more importance, particularly to new consumers, in the selection of equipment.

An obvious example to illustrate this point could be cited in the field of electricity use in irrigation. That is, the costs incurred by the use of electricity are minor compared with the fact that capital costs for electric motors are generally higher than those for diesel motors. Therefore, subsidizing electricity prices would probably have a minimal effect unless the cost of connection and pumps are themselves subsidized.

Within this context, developing countries can achieve the objectives of equity and efficiency by providing subsidies on the cost of equipment rather than on the price of electricity. In fact, subsidies may be provided on electric motors, and fluorescent tubes to provide incentives for the selection of appropriate[12] energy-efficient equipment and devices. These subsidies could take the form of general subsidies and be introduced through reductions in excise duties on those items. On the other hand, the subsidies could also be targeted[13]. That is, directed at a particular target group for which elaborate administrative arrangements would have to be made.

However, there may be difficulties in implementing some of these proposals because energy-efficient equipment which is subsidized would affect the demand for existing manufacturing units which may be in the small, unorganized sector. Thus, in the small-scale industries, there may be a conflict between providing energy-efficient stoves and pump-sets, and employment.[14]

In terms of foreign exchange considerations also, it may appear particularly worthwhile to price electricity competitively, so that it can replace kerosene for lighting, and diesel oil for motive power.[15]

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[12]From the viewpoint of society.

[13]In other words, of special purpose.

[14]And therefore, income.

[15]Provided that electricity generation is not based on oil imports.

5. Summary and conclusions:

For over half a century, the Egyptian government has introduced subsidies as means of insulating its various economic sectors from price increases. However, it was only since the socialist revolution of 1952, when the government initiated an intensive subsidy programme which entailed the implementation of different forms and types of subsidy. Some of which were intended to protect the poor and low-income segments of the society from large price increases in a manner which would ensure that they received an acceptable minimum level of basic needs especially those of the necessities such as food and energy. The subsidy programme has however, been extended to a great array of other services such as education and health as well. In fact, subsidy on both domestic and imported food has constituted the bulk of all subsidy in Egypt since the 1970's.

However, the more serious aspect of the subsidy programme is that of energy. It is quite clear that, whereas the general trend has been a gradual decline in subsidies, those of energy have been increasing substantially even with the decline in the international price of oil. Within the prospect of electricity subsidies, the Aluminium Complex and the Kima Fertilizer Plant in Egypt accounted for the majority of the electricity subsidy for a number of years. As their share in electricity subsidy has declined gradually, that of the residential sector assumed a much greater share and is anticipated to receive more subsidy despite the government's efforts to increase electricity prices successively since the early 1980's to date.

With regard to the economic effects, the adoption of the intensive subsidy programme in Egypt has resulted in a number of negative impacts on both the internal and external balances of the economy. These are manifested in the chronic deficits of the government budget, adverse effects on the balance of payments, and fuelling domestic rates of inflation, apart from other negative impacts. In the field of energy, the negative effects of low subsidized energy prices were more apparent in terms of a rapid depletion of indigenous oil resources, and a reduced foreign exchange revenues resulting from less oil available for exports.

In fact, it has been widely argued that most of the problems facing the Egyptian economy at present, which have impeded its recovery for a considerable time, are the direct result of adopting the subsidy programme with all its aspects so extensively to the extent that it has become so complex and pervasive in the system in a way that has rendered its evaluation quite a difficult task. Furthermore, high voices have more recently called for a complete abolition of all forms of open-ended (general) subsidies in Egypt to be replaced by other alternative means which would seek the same objectives as those of subsidies in such a way that would reconcile the equity and efficiency objectives sought in electricity pricing.

Nevertheless, with regard to equity, we have indicated in the chapter that Egypt, among many developing countries, has set out to subsidize the cost of electricity for the low-income segments of the society as well as extend electrification to rural areas. Subsidizing the cost of electricity is usually achieved through the implementation of life-line rates. However, this equity objective is not met very often for the simple fact that the subsidies do not reach those groups whom it is designed for. That is, this particular type of subsidy is very hard to confine to a particular group, and hence, the benefits of this subsidy accrue to the rich since it is difficult to exclude them. It is also very well the case in rural electrification projects whereby the initial cost of wiring is high for the rural poor, and thus, only the rural rich get the full benefit of the rural electrification programme as well as the subsidy. In fact, we have presented several alternatives to the system of subsidies currently in use in Egypt. One solution would be to introduce targeted subsidies. That is, to issue coupons redeemable against electricity bills as well as other energy products, provided that the value of these coupons vary according to household income and that they are non-tradeable so that they are not resold and thus, the rich would be excluded from receiving this kind of subsidy. However, there is a variety of administrative problems associated with the coupon programme which makes it difficult as well as expensive to implement.

With regard to rural electrification, we recommended that the government should extend the scope of its expenditure to include the costs of internal wiring of rural houses. This would thus lead to a significant increase in the number of rural households connected to the service, who would have otherwise been excluded on the basis of costs alone.

In any of the alternatives we have proposed, it is clear that the abolition of the electricity subsidy would most definitely result in a reduced consumption of electricity as there would be less wasteful consumption and more conservation measures being implemented simultaneously. Moreover, the government would be satisfied in achieving its efficiency objectives by pricing electricity at its competitive price while still be able to supply the poorer segments of the population with their basic electricity needs.

Nonetheless, the subsidy programme currently adopted in Egypt, especially that for electricity, has had many shortcomings while its success has been limited in certain aspects. Therefore, an overall assessment of this programme has to be undertaken and alternative tools can then be evaluated and adopted. An additional task within the same lines is to structure electricity tariffs which would take into consideration low-level consumption (poorer consumers), while recovering the deficit through charging the well-off electricity consumers above marginal cost. Such a suggestion will be analyzed in chapter 5 where various pricing scenarios for the residential sector will be presented and evaluated in terms of expenditure, revenues, and most importantly the welfare cost each scenario entails.

CHAPTER FOUR

ELECTRICITY TARIFFS IN EGYPT:
PAST AND PRESENT

1. Introduction:

Undoubtedly, the demand for electricity in Egypt has exhibited substantial increases in the last two decades or more and is yet expected to grow much further, well into the 21^{st} century. The electricity authorities in Egypt are becoming more aware of the fact that massive investments are needed in order to be able to meet the anticipated upsurge in electricity demand in the future.

In fact, there are current fears that an increase in the load factor (i.e., an increase in the number of hours of operating generating units) coupled with a decline in the reserve margins - necessary to allow for maintenance and derating of these units - may eventually lead to a short-fall in electricity supply. In brief, one can clearly notice that the ever increasing trend of electricity demand can have three important implications related to the depletion of indigenous oil resources, to export revenues, and finally to the government's finances. The first implication stems from the fact that hydropower in Egypt has reached its maximum capacity and thus, the increase in electricity demand has to be met through the increased reliance on thermal electricity generation. This in turn, leads to an increased pressure to apply high depletion rates on the indigenous oil products used as fuel in thermal electricity generation plants. Secondly, the increased reliance on thermal generation required to meet the upsurge in electricity demand reduces the available volume of exportable oil and thus, deprives the government of invaluable export revenues in addition to foreign exchange earnings. Thirdly, it constrains the government budget further by having to allocate massive funds necessary to invest in the construction of new power stations to cater for the upsurge in electricity demand.

The lack of available investment funds, however, coupled with the inability of the electricity sector to generate enough revenues - due to low electricity prices - have led to a delay in many of the planned power facilities. In fact, the five-year economic and social plan of 1982/83 - 1987/88 [32] had targeted an initial outlay of around L.E. 6.9 billion for investments in the electricity sector. In the actual execution of the five-year plan, this figure was reduced by over 60%, to reach only L.E. 2.5 billion. This drop was mainly due to an overall decline in governmental revenues from oil exports as their prices declined significantly in international markets during that period. Thus, as a direct result, many of the electricity projects opted for in the five-year plan to increase installed and generating capacity were postponed indefinitely. Such a delay, implies an inevitable gap between the demand for electricity and its supply in the short-run; if not in the medium-term.

Within this context, there is a pressing need to curb the demand for electricity; most notably that of the residential sector as it appears to exhibit the highest growth amongst other electricity consuming sectors. The key element in achieving such a task is believed to hinge upon reforming the electricity tariff structure in an attempt to correct the imbalance between actual costs and selling prices of electricity. Thus, section 3 in this chapter will be primarily concerned with the task of analyzing the demand for electricity in the residential sector within the overall context of electricity demand in Egypt. However, reviewing the development of residential demand for electricity ought to be supplemented with a detailed analysis of residential tariffs in Egypt. Therefore, section 4 will be devoted to studying residential tariffs in a historical prospective. In addition, an effort will be made to analyse expenditure on electricity at different consumption levels. Moreover, we will attempt to study household expenditure on electricity and its main substitute (i.e., kerosene). We will also compare the residential tariffs in Egypt with those of other developing countries in order to assess the possible similarities and differences. As a background to this analysis, however, it is useful to proceed first by discussing the different stages through which electricity was introduced ~~in Egypt~~.

2. Electricity in Egypt: a historical note:

Electricity was first introduced in Egypt by the end of the last century. Its use was then limited to lighting, after which its utilisation became more developed and varied alongside the growth of the Egyptian economy. There are three distinct stages in the development of electricity utilisation in Egypt [30]. The first stage spanned from the early years of electricity in Egypt up to 1930. The second stage covers the period 1930 - 1952, while the third and final stage corresponds to the time-period 1952 to date.

Stage 1

Up to 1930, electricity use was confined to lighting, both in residential and commercial areas. In addition, there were small and limited uses of electricity to drive electric fans, irons and lifts. Nonetheless, natural gas was the main fuel used in public lighting in the two major cities of Egypt (i.e., Cairo and Alexandria), while other cities relied on electricity generated from small diesel engines for public lighting.

It appears that electricity played no role in the field of moving power due to the fact that machines driven by diesel oil were used in industries and irrigation. With regard to traction, electricity was used for this purpose in both Cairo and Alexandria.

Stage 2

In this stage, electricity use was extended to other purposes such as refrigeration and radio appliances. In brief, its role was widening to include other domestic uses besides lighting. In addition, a gradual phase-out of natural gas to be replaced by electricity took place in this particular stage. Thus, electricity became increasingly utilised by public utilities and irrigation. Moreover, as the Egyptian government at that time had set-out to protect infant industries (e.g., textiles, cement, and fertilisers), it aimed at providing them with ample amounts of electrical energy. However, electricity in this time-period did not replace mechanical power in generating moving power and thus, both forms of energy were used alongside.

<u>Stage 3</u>

The final stage represents a major turning-point in the political, social, and economic structure of the Egyptian economy [30]. The social revolution of 1952 resulted in a substantial change in terms of the industrial orientation of the economy. In brief, there was a complete shift from light industries towards much heavier energy-intensive industries such as iron and steel, aluminium, and fertilizers. At the same time, other new transformational processing industries (i.e., for agricultural produce) were initiated. In fact, the use of electricity as a moving power was substantially increased and its consumption in the productive sectors has also surged upwards. Moreover, electricity was gradually replacing mechanical power in many industries (e.g., petrochemicals and fertilizers), in addition to other activities which consumed massive quantities of electricity such as radio and television, and electrical traction through the electrification of some railway lines. With regard to domestic uses, as household income increased, the stock of electrical appliances also increased, most notably, air conditioners, fridge-freezers, and T.V. and video sets. Finally, this stage also witnessed a massive programme by the socialist revolution to electrify rural areas.

Before the establishment of the Ministry of Electricity in 1964, the generation, transmission and distribution of electricity was delegated to four authorities: Electricity and Gas Administration (EGA) in Cairo, EGA in Alexandria, Electricity and Mechanics Department, and municipalities in cities which had smaller generating units. Completely decentralised in terms of financial, administrative, and technical aspects, each authority had its own pricing structure. This situation persisted until 1970 when - through legislation - a unified national electricity tariff was to be applied in all the geographical areas of Egypt. In fact, the 1970 legislation stipulated that the tariffs already implemented in Cairo were to be applied nationwide. However, the large industrial consumers were excluded in the bill and thus, continued to receive preferential electricity rates.

3. Development of electricity consumption in Egypt:

3.1. Consumption by sector:

Table (4.1) presents the data for annual electricity consumption in Egypt for the period 1980/81 - 1988/89, which shows that aggregate consumption has more than doubled from around 16 billion KWH in 1980/81 to reach almost 32 billion KWH in 1988/89; at an average growth rate of 9.3% per annum. It has been estimated that electricity consumption may reach 75 billion KWH in 1995 and around 100 billion KWH by the year 2000 [33]. The Table also indicates that despite the domination of industry in the overall consumption profile, its relative share has declined from 59% in 1980/81 to 48% in 1988/89, and only achieved an average growth rate of 6.6% per annum. Both the agriculture sector and the public utilities sector (the latter includes the government sector as well) have maintained more-or-less their same relative shares in consumption throughout the period 1980/81 - 1988/89.

On the other hand, the same Table indicates that the share of the residential sector in aggregate consumption has increased substantially (more than tripled) during the same period; that is, its consumption of electricity has increased from 3.5 billion KWH in 1980/81 to 11.2 billion KWH in 1988/89, an increase of around 67%, at an average growth rate of 15.5% per annum, which is by far the biggest growth

Table (4.1)

Annual Electricity Consumption in Egypt
by Sector
1980/81 - 1988/89
in Million KWH

Year	1980/81		1981/82		1982/83		1983/84		1984/85		1985/86		1986/87		1987/88		1988/89		Growth Rate*
Sector	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	(%)
Industry	9186	59%	9593	56%	10270	52%	11494	51%	11758	49%	12758	49%	13894	49%	14710	48%	15220	48%	7%
Agricult	777	5%	836	5%	942	5%	1048	5%	1108	5%	1197	5%	1166	4%	1221	4%	1303	4%	7%
Resident	3583	23%	4373	25%	5464	28%	6816	31%	7762	33%	8850	34%	9755	34%	10824	35%	11157	35%	15%
Pub Util & Govern	1786	11%	2027	12%	2547	13%	2561	11%	2633	11%	2851	11%	3132	11%	3182	10%	3342	11%	8%
Others	259	2%	337	2%	395	2%	411	2%	500	2%	507	2%	564	2%	608	2%	668	2%	13%
Total	15591	100%	17166	100%	19637	100%	22331	100%	23762	100%	26163	100%	28511	100%	30545	100%	31690	100%	9%
Annual Rate of Increase	10%		10%		14%		14%		6%		10%		9%		7%		4%		

NOTES: 1) the consumption figures correspond to electricity supplied by both EEA and Distribution Companies
2) * denotes the average annual growth rate for the period 1980/81 to 1988/89

SOURCE: EEA [25] Annual Report of Electricity Statistics, several issues amongst all sectors. As a result, its share relative to the other sectors, has jumped from 23% to 35% during the same period as indicated by Table (4.1).

3.2. Consumption by voltage level:

In Egypt, electricity is supplied through two main channels. The first channel is a direct hook-up to the grid by bulk consumers of electricity on Ultra High Voltage (UHV), High Voltage (HV), and Medium Voltage (MV). These large consumers are mainly the major industrial and agricultural firms whereby each has its own contracted pricing structure on individual basis. This particular type of direct supply represented 30% of aggregate consumption in 1979 as shown in Table (4.2), though it has declined to around 24% in 1986/87 due to the significant reduction in industrial consumption of electricity in general.

The second channel is basically whereby the Egyptian Electricity Authority (EEA) supplies electricity to the different distribution companies which are located throughout the different geographic zones of Egypt. Complementary to the decline of the share of the bulk electricity consumers, Table (4.2) indicates that the share of the distribution companies in total electricity consumption has increased from 70% in 1979 to over 76% in 1986/87. In fact, had the data been available to date, one could be almost certain that the distribution companies would have most definitely increased

TABLE (4.2)

SHARES OF ELECTRICITY SALES IN EGYPT
BY VOLTAGE LEVEL
1980/81 - 1988/89

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89
UHV	25.1%	23.7%	23.3%	21.5%	19.3%	19.4%	17.7%	17.1%	17.2%
HV	4.9%	6.0%	6.9%	6.4%	6.2%	6.1%	6.3%	6.4%	6.0%
MV	---	---	---	0.1%	0.3%	0.3%	0.6%	0.6%	0.6%
DIS CO's	70.0%	70.2%	69.8%	72.0%	74.2%	74.2%	75.5%	75.9%	76.2%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NOTES:
UHV: ultra high voltage, used in supplying the largest five electricity consuming plants (industrial)
HV: high voltage, used in agriculture and industry
MV: medium voltage, also used in both agriculture and industry
DIS CO's : distribution companies in charge of reselling electricity on MV & LV to various sectors

SOURCE: EEA annual report of electricity statistics [25], several years 1982 - 1989 their share relative to the decline in industrial electricity consumption by the bulk customers.

It is nonetheless abundantly clear from the foregoing discussion that the distribution companies in general and the residential sector in specific have assumed a much greater share in the overall profile of electricity consumption in Egypt in the last decade or so. Therefore, we find it necessary to study more closely the residential sector within the overall framework of the distribution companies.

3.3. Consumption through the distribution companies:

In general, the distribution companies in Egypt are responsible for supplying[1] electricity to different sectors on the MV and LV. Once again, as Table (4.3) indicates, there was a clear domination by the industrial sector in 1980/81 whereby it consumed over 4 billion KWH representing around 42% of total sales of distribution companies. By 1988/89, its relative share has dropped to around 32% which implies a drop of 9% from its 1980/81 level, and was only able to realize a modest average growth of almost 8% during the same period. In fact, all the other sectors - except the residential sector - have exhibited a decline in their relative shares during this period.

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[1]This may include generation and transmission as well as distribution of electrical power.

Table (4.3)

Electricity Supplied by Distribution Companies
to Different Sectors
1980/81 - 1988/89
in Million KWH

YEAR	1980/81		1981/82		1982/83		1983/84		1984/85		1985/86		1986/87		1987/88		1988/89		Share (+/-) * (%)	Aver Inc p.a. (%)
SECTOR	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)	MKWH	(%)		
Indust	4278	42%	4821	40%	5316	38%	5734	36%	6080	35%	6631	34%	7227	34%	7330	33%	7665	32%	-9%	8%
Agricult	336	3%	359	3%	336	2%	379	2%	468	3%	456	2%	413	2%	501	2%	676	3%	-1%	10%
Utilit	1154	11%	1542	13%	1819	13%	1747	11%	1761	10%	1976	10%	2192	10%	2057	9%	2165	9%	-2%	9%
Gover	612	6%	517	4%	697	5%	783	5%	789	5%	852	4%	940	5%	1122	5%	1118	5%	-1%	9%
Resid	3582	35%	4432	37%	5484	39%	6816	43%	7794	45%	8888	46%	9755	46%	10824	48%	11471	48%	13%	16%
Others	259	3%	335	3%	372	3%	421	3%	490	3%	506	3%	564	3%	618	3%	662	3%	0%	13%
Total	10221	100%	12006	100%	14024	100%	15880	100%	17382	100%	19306	100%	21090	100%	22452	100%	23756	100%	0%	

NOTES: 1) figures may not add up due to rounding off
2) * denotes the change in the sectors share in total electricity consumed throughout the same period

SOURCE: Public Sector Organisation for Electrical Power Distribution, Egypt, Annual Statistical Report [66], several issues

In contrast to the decline in industrial share, the same Table, (i.e., Table (4.3)), indicates that the residential sector has increased its share by over 13%; that is, its relative share has jumped from 35% in 1980/81 to over 48% in 1988/89 which stands in marked contrast to the decline in all the shares of the other sectors during the same period. Furthermore, its consumption has increased from 3.5 billion KWH in 1980/81 to 11.5 billion KWH in 1987/88, an increase of over three-fold, at an average rate of 16% per annum.

The argument presented so far suggests that the decline in the relative shares of sectoral electricity consumption in Egypt in the last decade is caused by the upsurge of the share of the residential sector relative to the other sectors. In fact, the share of the residential sector has reached almost 50% of aggregate electricity sales by the distribution companies in Egypt in 1987/88, and is yet expected to increase much further.

Many factors can be contributed to this upsurge in residential electricity consumption, primarily among them are those of population growth and higher household incomes. However, the most important factor of all is the past (and present) electricity tariff prices which were highly subsidised and thus bore no relation to actual cost. Inefficient prices have in fact, encouraged wasteful and unnecessary consumption patterns coupled by a much reduced role for electricity conservation and rationalization.

3.3.1. Consumption: quantity versus value:

Table (4.4) presents the value of electricity sales by the distribution companies throughout the period 1985/86 to 1988/89. The Table indicates that in all the sectors - except for the residential sector - there is a more-or-less balance between share in total consumption and that in total value. However, the same Table shows a marked change with regard to the residential sector. In 1985/86, this sector consumed 46% of total electricity supplied by the distribution companies in Egypt while contributed 44% to the total sales revenues in that year. However, by 1988/89, the same sector had increased its share in total consumption to 48% while its contribution to sales revenues had declined steadily to reach only 37%. Thus, the Table quite explicitly indicates that the residential sector contributes far less to the overall electricity sales revenues relative to that of any of the other sectors. Within this context, the issue of residential tariffs or more broadly the electricity tarification policies in Egypt emerges as a cornerstone to curbing electricity demand.

In fact, not only does the electricity sector grant an implicit subsidy in the form of reduced electricity prices, it in turn receives implicit subsidy from the oil sector; that is, the former purchases oil products from the latter at heavily subsidised prices. Even on calculating the costs of electricity supply at those subsidised oil prices, there is

Table (4.4)

Quantity & Value of Electricity Supplied by Distribution Companies
to Major Sectors
1985/86 - 1988/89
(Million KWH & Million L.E.)

	1985/86				1986/87				1987/88				1988/89			
	Cons MKWH	(%)	Value M L.E.	(%)	Cons MKWH	Share (%)	Value M L.E.	Share (%)	Cons MKWH	Share (%)	Value M L.E.	Share (%)	Cons MKWh	Share (%)	Value M L.E.	Share (%)
I	6631	34%	184	36%	7227	34%	215	36%	6733	30%	265	32%	7665	32%	309	33%
A	456	2%	9	2%	413	2%	12	2%	501	2%	22	3%	676	3%	25	3%
U	1976	10%	53	10%	2192	10%	68	11%	2057	9%	102	12%	2165	9%	133	14%
G	852	4%	37	7%	940	5%	40	7%	1122	5%	60	7%	1118	5%	72	8%
R	8888	46%	226	44%	9755	46%	257	43%	10824	48%	322	39%	11471	48%	347	37%
O	506	3%	8	2%	564	3%	10	2%	1214	5%	49	6%	662	3%	15	2%
T	19306	100%	518	100%	21090	100%	601	100%	22452	100%	819	100%	23756	100%	931	100%

NOTES:
a) figures do not add up due to rounding off
b) I: industry, A: agriculture, U: public utilities
G: government, R: residential, O: others, T: total

SOURCE: Public Sector Organisation for Electricity Distribution, Egypt, Annual Statistical Report [66] several issues further evidence suggesting that the electricity sector undercuts its prices massively, as we shall elaborate fully in the next section on analyzing residential tariffs.

The foregoing discussion, asserts that the residential sector has played an important role in the overall profile of electricity consumption in Egypt. Moreover, it may be argued that this sector is expected to assume a much greater share in aggregate electricity consumption in Egypt as real incomes increase[2] and population growth rates are sustained well into the future. One has therefore to acknowledge the fact that managing the demand for electricity in Egypt has to consider the potential growth of the residential sector relative to the other sectors. In fact, one of the main reasons why this sector has exhibited high consumption patterns is due to the inability of the pricing structure to indicate to consumers the true economic costs of electricity. Thus, consumers were enticed to increase their consumption and refrain from adopting any retrofitting or better housekeeping measures which eventually lead to wasteful consumption.

[2]Despite the fact that the income elasticities of electricity demand estimated in Chapter 1 were either insignificant or of the wrong sign, one can still argue that as real incomes increase, one would expect residential customers to buy more electrical durables, and thus, to consume more electricity.

3.4. Consumption per capita and per customer:

Table (4.5) presents the figures for the total and per capita electricity consumption of both the EEA and the distribution companies throughout the period 1980/81 - 1988/89. The Table indicates that while the consumption of EEA was increasing at around 9% p.a. on average during that period, that of the distribution companies was higher at 11%. The same Table shows almost the same pattern with regard to the per capita consumption of the distribution companies which has also exceeded that of the EEA in the period 1980/81 - 1988/89. One can attribute this to the high growth rates exhibited by the residential sector during that same period.

An interesting observation can be made by studying Table (4.6) where the growth rates of total, per capita, and per customer residential consumption are calculated and presented. The Table indicates that total residential consumption has been increasing at an average rate of around 16% p.a. during the period 1980/81 to 1988/89. After adjusting for population, the per capita residential consumption grew at around 13% p.a. on average. From a different perspective, the same Table indicates that the growth in residential consumption per customer[3] during the same period has only averaged around 7% p.a., implying that the magnitude of the increase in new household connections

[3] That is, household, as each household is only entitled to have one connection and thus, one meter.

TABLE (4.5)

TOTAL & PER CAPITA ELECTRICITY CONSUMPTION IN EGYPT
(FROM EEA & DIST CO'S)
1980/81 - 1988/89

YEAR	POPULATION MILLION	POPULATION INDEX	EEA CONSUMPTION TOTAL M KWH	EEA INC (%)	EEA INDEX	EEA P/C KWH	EEA P/C INC (%)	EEA P/C INDEX	DISTRIBTION COs CONSUMPTION TOTAL M KWH	DIST INC (%)	DIST INDEX	DIST P/C KWH	DIST P/C INC (%)	DIST P/C INDEX
1980/81	43.3	100	15591	---	100	360	---	100	10221	---	100	236	---	100
1981/82	44.5	103	17166	10%	110	386	7%	107	12006	17%	117	270	14%	114
1982/83	45.8	106	19637	14%	126	429	11%	119	14024	17%	137	306	13%	130
1983/84	47.2	109	22331	14%	143	473	10%	131	15880	13%	155	336	10%	143
1984/85	48.5	112	23762	6%	152	490	4%	136	17382	9%	170	358	7%	152
1985/86	49.9	115	26163	10%	168	524	7%	146	19306	11%	189	387	8%	164
1986/87	51.3	118	28511	9%	183	556	6%	154	21090	9%	206	411	6%	174
1987/88	52.7	122	30545	7%	196	580	4%	161	22452	6%	220	426	4%	181
1988/89	54.2	125	31690	4%	203	585	1%	162	23756	6%	232	438	3%	186
AVERAGE ANNUAL GROWTH RATE				9%			6%			11%			8%	

SOURCES: 1) EEA ANNUAL STATISTICAL REPORTS [25]
2) PUBLIC ORGANISATION FOR ELECTRICITY DISTRIBUTION, EGYPT, ANNUAL STATISTICAL REPORT [66]
3) CAPMAS [12] ANNUAL STATISTICAL REPORTS, FOR POPULATION FIGURES

TABLE (4.6)

RESIDENTIAL ELECTRICITY CONSUMPTION IN EGYPT
PER CAPITA & PER CUSTOMER
1980/81 - 1988/89

YEAR	POPULATION MILLION	POPULATION INDEX	RESID'L CUSTOMERS 000's	RES'L CONS M KWH	INC RATE (%)	INDEX	RES'L P/C KWH	INC RATE (%)	INDEX	CONS PER CUSTOMER KWH	INC RATE (%)	INDEX
1980/81	43.3	100	5126	3588	---	100	83	---	100	700	---	100
1981/82	44.5	103	5723	4432	24%	124	100	20%	120	774	11%	111
1982/83	45.8	106	6342	5484	24%	153	120	20%	144	865	12%	124
1983/84	47.2	109	7076	6816	24%	190	144	21%	174	963	11%	138
1984/85	48.5	112	7655	7787	14%	217	161	11%	193	1017	6%	145
1985/86	49.9	115	8166	8881	14%	248	178	11%	214	1088	7%	155
1986/87	51.3	118	8632	9744	10%	272	190	7%	229	1129	4%	161
1987/88	52.7	122	9171	10822	11%	302	205	8%	247	1180	5%	169
1988/89	54.2	125	9757	11471	6%	320	212	3%	255	1176	-0%	168
AVERAGE ANNUAL GROWTH RATE					16%			13%			7%	

SOURCES:
1) PUBLIC ORGANISATION FOR ELECTRICITY DISTRIBUTION, EGYPT, ANNUAL STATISTICAL REPORTS [66]
2) CAPMAS [12] ANNUAL STATISTICAL REPORT, FOR POPULATION FIGURES

did not keep up with that of per capita consumption. In other words, the increase in the residential consumption of a single Egyptian during the period 1980/81 to 1988/89, has outstripped that of a single residential customer. More precisely, this could be interpreted to imply that residential electricity consumption has increased per household by far more than that per individual.

One of the main reasons that could be attributed to such a trend is the acquisition of electrical durables by households as the latter's incomes increase in addition to the gradual substitution of electricity for other traditional sources of energy especially in rural households. On the other hand, such a trend may be simply attributed to a decline in the household size. However, due to the lack of data on household size or indeed that on household durables, one cannot substantiate the above reasons.

In the next section, we will review the electricity tariff structures for residential use in Egypt. The historical discussion will lead to the more recent developments in the residential tariffs in the last few years where we will analyse the various tariff structures in order to assess their impact on consumption and expenditure.

4. Residential electricity tariffs:

4.1. Average electricity prices and costs:

Electricity pricing since the early years of electricity in Egypt, has been based on the average cost concept. Up to the end of 1974, electricity tariffs in Egypt were based on a 1970 study by the Electricité de France (EDF), which provided an appropriate basis for calculating the cost of electricity supply. However, those tariff structures, even after the several consecutive increases, did not realistically reflect the cost of supply in economic terms nor even the general level of prices. Table (4.7) presents the data for electricity costs and prices averaged over different uses, voltage levels, and load factors throughout the period 1975 - 1986/87. Once again, despite the fact that costs were calculated by using the subsidised prices of oil products, the Table clearly indicates that average prices fell well below their average costs throughout that period. Furthermore, this situation has perpetuated even after the successive price movements, especially in the Eighties, Table (4.7) shows that they were unable to keep pace with inflation and thus, average real prices have declined by around 6% per annum on average. At 1975 prices, the Table indicates that on average, the gap between average prices and average costs has increased by 37% per annum from 1975 - 1986/87.

Table (4.7)

Average Sale Price & Average Cost
of Electricity in Egypt
1975 - 1986/87
in mills/KWH

YEAR	Nominal Price mills/KWH	Nominal Cost mills/KWH	Real Price (1) mills/KWH	Growth Rate (%)	Real Cost (2) mills/KWH	Growth Rate (%)	(1) - (2) mills/KWH	Growth Rate %
1975	9.1	9.6	9.1	---	9.6	---	-0.5	---
1976	8.6	9.9	8.0	-12.0%	9.2	-4.0%	-1.2	142.1%
1977	8.0	9.2	6.8	-15.3%	7.8	-15.3%	-1.0	-15.9%
1978	8.6	9.5	6.4	-6.3%	7.0	-10.0%	-0.7	-34.6%
1979	7.4	7.6	5.0	-21.5%	5.1	-27.0%	-0.1	-79.7%
1980	7.5	8.3	4.2	-16.6%	4.6	-10.2%	-0.4	229.0%
1980/81	7.4	8.8	3.8	-8.9%	4.5	-2.1%	-0.7	61.6%
1981/82	7.6	9.1	3.6	-6.1%	4.3	-5.4%	-0.7	-2.0%
1982/83	8.3	9.7	3.4	-5.7%	3.9	-8.0%	-0.6	-19.4%
1983/84	9.8	10.7	3.6	7.2%	3.9	0.1%	-0.3	-41.7%
1984/85	11.0	14.1	3.6	-0.8%	4.6	16.4%	-1.0	204.3%
1985/86	15.4	18.7	4.3	19.4%	5.2	13.1%	-0.9	-9.2%
1986/87	16.4	20.6	4.0	-6.3%	5.0	-3.1%	-1.0	12.0%
Average Annual Growth Rate				-6.1%		-4.6%		37.2%

NOTES: 1) average cost is calculated using subsidised prices for oil products
2) average price includes both distribution companies and large bulk customers
3) Wholesale Price Index (WPI) was used to deflate nominal values, where 1975 = 100

SOURCES: 1) EEA Department of Electricity Pricing, 1988 [28]
2) CAPMAS Statistical Yearbook [12], several issues, for WPI

In terms of rate of return, the electricity authority in Egypt (EEA) before 1978, was attempting to achieve minimum rates of return of 3% on the fixed assets where the latter were not valued at replacement cost, but at historical cost adjusted for inflation [49]. However, through a World Bank loan agreement [32], the EEA was required to secure a 5% rate of return in 1980, 6% in 1981, 8% in 1982 and 9% each year from 1983 onwards. Despite the lack of data on actual rates of return applied by the EEA, there is much doubt that they were achieved at any point in time.

4.2. Development of residential tariffs and expenditure:

Throughout the Sixties, the electricity tariff applied in Greater Cairo for domestic uses, which was also applied nationwide in 1970, was a flat rate of 10 mills/KWH. This rate represented only the actual charge for electricity consumption per unit while a residential consumer was also charged a further 8 mills/KWH (56% of total) for other duties (i.e., tax and stamps) which were collected on behalf of the Treasury.

However, in 1975, this flat rate for residential electricity consumption was replaced by a regressive two-block tariff as indicated by Table (4.8).

In March 1980, the declining two-block tariff structure was completely abolished; instead, a three-block progressive tariff structure was introduced for residential electricity use as shown in Table (4.9).

Table (4.8)

Residential electricity tariff in Egypt in 1975 (mills/KWH)

Block (KWH/month)	Rate (mills/KWH)	Expenditure (L.E./month)
1 - 45	16.5*	0.74
above 45	10.0**	----

NOTES:

* excluding 6 mills/KWH for stamps and broadcasting duties.

** excluding 4 mills/KWH for stamps.

SOURCE: EEA Department of Electricity Pricing [28].

In fact, the logic behind replacing the regressive tariff structure for a progressive one, was to introduce more-or-less more accurate signals to electricity consumers whereby it would indicate to them that more consumption entails higher costs and thus, higher prices. Therefore, this was an attempt on the government's side (i.e., supply-side) to curb unnecessary and wasteful consumption patterns while simultaneously try to approach more realistic and acceptable rate of return on investments in the electricity facilities.

Table (4.9)

Residential electricity tariff in Egypt

in 1980 (mills/KWH)

Block (KWH/month)	Rate (mills/KWH)	Expenditure (L.E./month)
1 - 80	16	1.3
81 - 250	17	2.5
above 250	18	----

SOURCE: EEA Department of Electricity Pricing [28].

However, there appears to be very small differences between the marginal tariffs in the 1980 tariff structure as indicated by Table (4.9). Therefore, despite the attempt to introduce a progressive tariff, less effort was made to influence demand pattern by structuring the marginal tariffs in such a way that would indicate to customers the correct cost signals high consumption levels entail.

In the 1982 tariff, there were four tariff slabs whereas in the previous 1980 tariff, there had been only three slabs and the limits for each block was changed. That is, as Table (4.10) indicates, the upper limit of the second block was reduced to only 100 KWH/month, and thus, the final block corresponded to consumption above that level, while the first slab (up to 80 KWH/month) was left unchanged. With regard to prices, the tariff for consumption for the slab of 100 to 250 KWH/month stood at 19.8 mills/KWH. Consumption in excess of 250 KWH/month was charged at 21.6 mills/KWH. Overall, the 1982 tariff has in fact, brought about an average real price decline of 9.7% on average over the 1980 tariff structure.

However, within only few months from the application of the 1982 tariff rates, the Cabinet Supreme Committee for Pricing (i.e., the government body responsible for public utility pricing in Egypt), had introduced yet another tariff structure for the residential sector which became effective in March 1983. The new 1983 tariff maintained the same number of slabs (i.e., four slabs), and left the first slab unchanged at its previous 1982 tariff, that is, at 16.2 mills/KWH as shown in Table (4.10). Freezing the price of the first block implied a decline in real terms of around 14% as the Table shows. The second slab increased to 20.6 mills/KWH from its previous 1982 level of 18.7 mills/KWH which represents a real decline of 5%. The third tariff block has also increased by 10% in nominal terms, that is, from 19.8 mills/KWH in 1982 to 21.8 mills/KWH, nonetheless, this also meant that it had decreased by 5% after adjusting for inflation. The fourth and final tariff block corresponds to consumption above 250 KWH/month whereby the price has increased to 25.9 mills/KWH; an increase of 20% and 4% in nominal and real terms respectively.

Overall, Table (4.10) indicates that the 1983 tariff structure has led to an average increase of almost 10% in all

Table (4.10)

Residential Electricity Tariff Rates & Expenditure
in 1982, 1983 & 1984
in Current & 1982 Prices
(mills/KWH & L.E./month)

Tariff Blocks	17/11/1982		1 / 4 / 1983							1 / 1 / 1984							
					1982			1982				1982				1982	
	Tar m/KWH	Exp L.E.	Tar m/KWH	Inc (%)	prices m/KWh	Inc (%)	Exp L.E.	prices L.E.	Inc (%)	Tar m/KWH	Inc (%)	prices m/KWH	Inc (%)	Exp L.E.	Inc (%)	prices L.E.	Inc (%)
1 - 80	16.2	1.3	16.2	---	14.0	-14%	1.3	1.1	-14%	16.5	2%	12.9	-7.6%	1.3	2%	1.0	-8%
81 - 100	18.7	1.7	20.6	10%	17.8	-5%	1.7	1.5	-12%	22.6	10%	17.7	-0.4%	1.8	4%	1.4	-6%
100 - 250	19.8	4.6	21.8	10%	18.8	-5%	5.0	4.3	-7%	24.0	10%	18.8	-0.1%	5.4	8%	4.2	-2%
250 +	21.6	---	25.9	20%	22.4	4%	---	---	---	31.1	20%	24.4	9.0%	---	--	---	---
Average Growth				10%		-5%			-11%		10%		0.2%		5%		-5%

NOTE: growth rates are calculated over proceeding year

SOURCES: 1) EEA Department of Electricity Pricing [28], for tariff rates
2) CAPMAS Statistical Yearbooks [12], for Wholesale Price Index (WPI)

the tariff blocks, while at the same time that implying an average decline of around 5% in real terms.

With regard to expenditure, Table (4.10) shows that there appears to be very insignificant differences between the 1982 and the 1983 tariffs. However, on adjusting for inflation, a different picture is drawn whereby the overall expenditure have dropped by almost 11% on average; the decline of the first block being the largest amongst all the others at 14%.

At midnight of new year's eve of 1984, a new electricity tariff became effective. In essence, the then new tariff maintained the basic characteristics of the other two earlier ones in terms of tariff bands, though the price of each band was moved upwards. That is, the price of the first slab was increased by 2% to become 16.5 mills/KWH, while those of the second and third slabs were increased by around 10% from their previous 1983 levels to reach 22.6 mills/KWH and 24 mills/KWH respectively. The tariff rate for the fourth and final slab has increased to 31.1 mills/KWH. In real terms, however, the 1984 tariff has shown a very small increase of only 0.2% on average; the first slab has exhibited the biggest drop in all slabs where it declined by almost 8%, whereas the last slab has achieved a real increase of 9% over the previous 1983 tariff structure.

By looking once again at the same Table, it is clear that the overall expenditure has increased by only 4.5% on average though the expenditure incurred in the first block has remained almost the same at 1.3 L.E./month. After adjusting for inflation, the overall expenditure has dropped by around 5% on average.

On comparing the three tariff structures presented in Table (4.10), one can arrive at the conclusion that while there were price increases in all three tariffs of 1982, 1983 and 1984, these increases were offset by inflation. It appears that the pricing authority had attempted in all three tariff structures either to keep the price of the first block unchanged (as in the 1983 tariff) or to increase it by only 2% in nominal terms (as in the 1984 tariff), the result of which is a substantial price decline of the first tariff block in real terms. The reasoning behind that appears to be an attempt from the government to provide massive subsidies for the poor and low-income groups of society, to obtain their basic needs of electricity at low prices.[4]

From 1985 onwards, the EEA started to realise that the slabs which characterised all the previous tariffs, were graduated in a manner which did not take into consideration the consumer density per tariff block. In fact, it became apparent that the last two tariff slabs are broad, that is, 100 - 250 KWH/month and in excess of 250 KWH/month in the pre-1985 tariffs. Once again, in a case where a consumer has consumed above 250 KWH/month, there would be absolutely no incentive for him to alter his consumption level accordingly

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[4]The issue of electricity subsidies is discussed in some detail in Chapter 3.

since the tariff rate applied to him in this particular situation would be more-or-less a flat rate. In this sense, a review of the tariff slabs with regard to numbers and limits was deemed necessary by the electricity authority in Egypt.

In contrast to the previous three tariffs of 1982, 1983 and 1984, the July 1985 tariff introduced five new blocks, the first of which (i.e., to 100 KWH/month) combined the two blocks in the former tariff structures. Despite that, the price of the first block in the 1985 tariff dropped to 18 mills/KWH from an average of around 19.6 mills/KWH in the 1984 tariff, a drop of around 9% in nominal terms.

From the foregoing discussion, it is clear that there was a need to spread out residential electricity consumption so that electricity users were charged more realistically according to the level of their consumption. In brief, a revised tariff structure was needed where more blocks were to be introduced and thus, presenting an incentive for electricity users to base their consumption accordingly. For this reason, the EEA attempted to go one step further and introduce more tariff blocks in order to cater for those residential users whose consumption levels fell above the bounds of the 1985 tariff structure. Thus, in May 1987, a new ten-block tariff became effective. As Table (4.11) indicates, the charge for the first block was kept unchanged at 18 mills/KWH, representing a decline of 25% in real terms as shown in the same Table. In the other tariff blocks,

Table (4.11)

Monthly Residential Electricity Tariff Rates
in 1985 & 1987
& Monthly Expenditures
(in mills/KWH/month & L.E./month)

Tariff Blocks KWH	1 / 7 / 1985		1 / 5 / 1987				Tariff Change* (%)	Tariff Change** (%)	Expend Change* (%)	Expend Change** (%)
	Tariff m./KWh	Expend L.E.	Tariff m./KWH	Tariff 85 prices	Expend L.E.	Expend 85 prices				
1 - 100	18	1.8	18	14	1.8	1.4	0%	-25%	0%	-25%
101 - 200	29	4.7	30	23	4.8	3.6	3%	-22%	2%	-23%
201 - 350	36	10.1	38	29	10.5	7.9	6%	-21%	4%	-22%
351 - 500	44	16.7	46	35	17.4	13.1	5%	-22%	4%	-22%
501 - 650	49	24.1	60	45	26.4	19.8	22%	-8%	10%	-18%
651 - 800	49	31.4	70	53	36.9	27.7	43%	7%	18%	-12%
801 - 1000	49	41.2	80	60	52.9	39.7	63%	22%	28%	-4%
1001 - 2000	49	90.2	100	75	152.9	114.7	104%	53%	70%	27%
2001 - 4000	49	188.2	120	90	392.9	294.8	145%	84%	109%	57%
4000 +	49	----	140	105	----	----	186%	114%	----	---
Overall Increase							64%	18%	27%	-5%

NOTES: * increase between 1985 & 1987 tariff rates and expenditure in current prices
** increase between 1985 & 1987 tariff rates and expenditure in constant 1985 prices

SOURCES: 1) EEA Department of Electricity Pricing [28], for tariff rates
2) CAPMAS [12], for deflators (WPI)

nevertheless, there were progressive nominal price increases which reached over 185% at the final block.[5] In contrast to the progressive increase in nominal terms of the tariff charges, an opposite situation appears in real terms. That is, as previously mentioned, freezing the charge of the first block in the 1987 tariff has brought about a drop of 25% in real terms, all the other tariff blocks up to the fifth block have had their prices dropped regressively on adjusting for inflation. However, this declining trend was reversed above 800 KWH.

In brief, the 1987 tariff brought about a nominal average increase of 64% over the previous 1985 tariff. Taking inflation into consideration, the 1987 tariff had only been successful in bringing about only an average increase of 18%, though this real increase was concentrated in the second half of the tariff blocks where only a small proportion of the customers lied,[6] while the majority of the consumers who were concentrated in the first few blocks, enjoyed a real decline in electricity prices.

In this context, one can clearly see the logic behind the tariff increase in both nominal and real terms in the manner described above. That is, there is a tendency - whether rightly or wrongly - not to bring about tariff increases to the majority of electricity consumers; it is

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[5]It has to be noted though that the charge for the fifth block and above remains constant at 49 mills/KWH in the 1985 tariff.

[6]This point is evident from Table (4.12).

only to those believed to be involved in extravagant consumption. Figure (4.1) depicts graphically the six residential tariffs for the period 1980 - 1987 in real terms. The Figure clearly indicates that marginal tariffs at the lower end have declined whereas those at the top end have increased significantly in real terms during the same period.

With regard to expenditure, Table (4.11) shows that expenditure in the 1987 tariff[7] had increased by 27% on average over the 1985 tariff. Once again, expenditure increased in the last few blocks more significantly than in the first ones. In general, expenditure in real terms dropped by an average of around 5%. It is worth noting, nevertheless, that real expenditure has declined in the 1987 tariff for blocks above 1000 KWH.

Table (4.12) presents the various indicators of residential consumption in 1986/87, 1987/88, and 1988/89, with regard to the absolute and relative shares of consumption per block as well as those of consumer density per tariff block. The Table reports that in all the three financial years investigated, the first tariff block behaves in a completely contradictory manner in contrast to the other blocks. That is, the relative shares of consumption as well as consumers have declined in the first block in spite of their increase in absolute terms.

On the other hand, the same Table indicates quite the opposite case for all the other blocks where both the

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[7]That is, excluding the first block.

Figure (4.1)

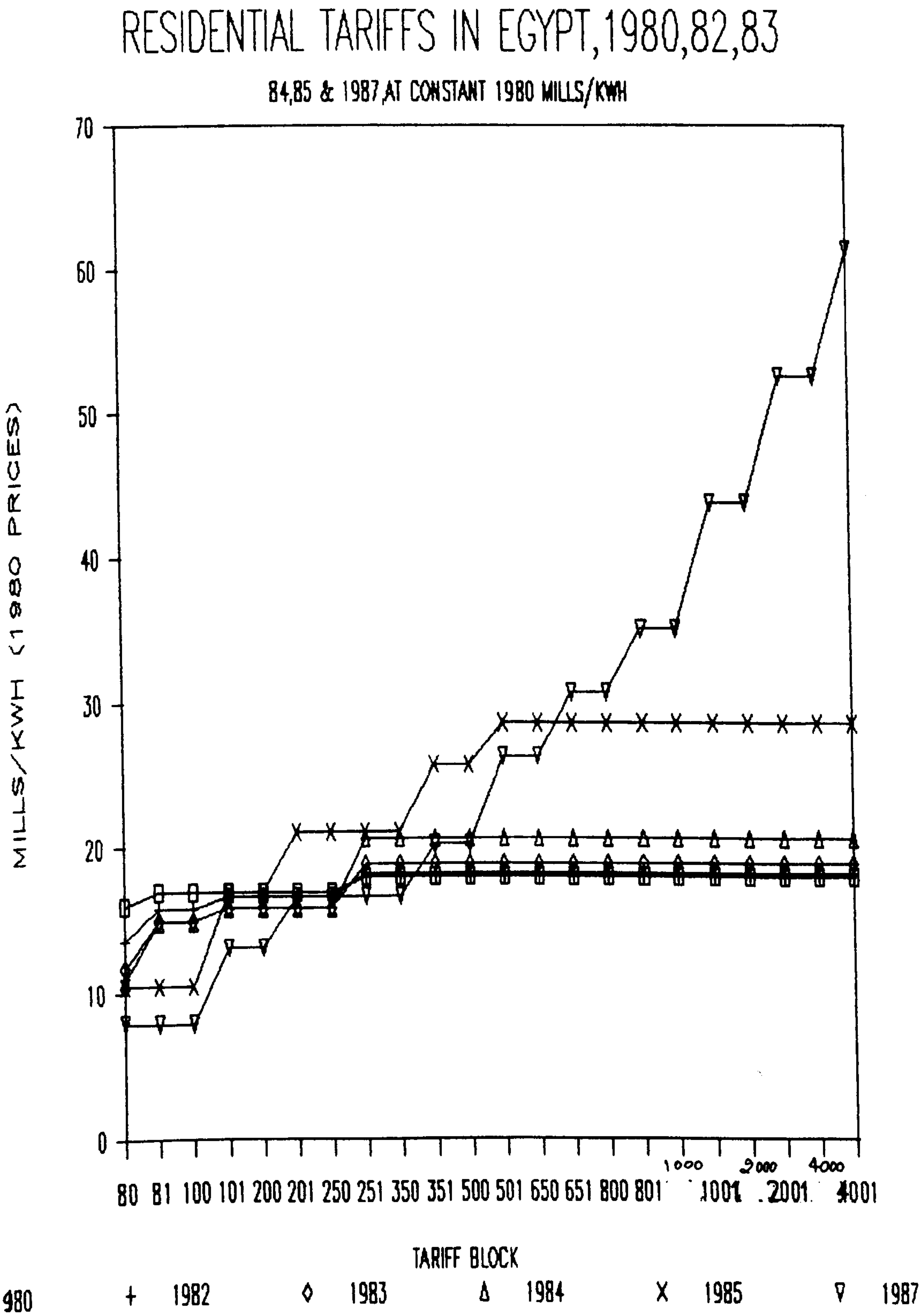

RESIDENTIAL TARIFFS IN EGYPT,1980,82,83
84,85 & 1987,AT CONSTANT 1980 MILLS/KWH
MILLS/KWH (1980 PRICES)
70
60
50
40
30
20
10
0
80 81 100 101 200 201 250 251 350 351 500 501 650 651 800 801 1000 1001 2000 2001 4000 4001
TARIFF BLOCK
□ 1980
+ 1982
◇ 1983
Δ 1984
X 1985
∇ 1987

Table (4.12)

Electricity Consumption in Residential Sector & Corresponding
Number of Customers per Consumption Block
1986/87, 1987/88 & 1988/89

Consumption Blocks KWH	1986/87				1987/88				1988/89			
	Cons'n MKWh	Share %	Customer Numbers	Share %	Cons'n MKWh	Share %	Customer Numbers	Share %	Cons'n MKWh	Share %	Customer Numbers	Share %
1 - 100	2751	28.2%	5929878	68.7%	2944	27.2%	6163181	67.2%	2810	24.5%	6458975	66.2%
101 - 200	3336	34.2%	1890311	21.9%	3702	34.2%	2081908	22.7%	4026	35.1%	2234298	22.9%
201 - 350	1922	19.7%	586946	6.8%	2241	20.7%	678684	7.4%	2673	23.3%	800054	8.2%
351 - 500	615	6.3%	112210	1.3%	714	6.6%	128400	1.4%	826	7.2%	156108	1.6%
501 - 650	371	3.8%	51789	0.6%	422	3.9%	64200	0.7%	459	4.0%	58541	0.6%
651 - 800	176	1.8%	17263	0.2%	184	1.7%	18343	0.2%	172	1.5%	19514	0.2%
801 - 1000	127	1.3%	8632	0.1%	130	1.2%	9171	0.1%	138	1.2%	9757	0.1%
1001 - 2000	293	3.0%	17263	0.2%	271	2.5%	18343	0.2%	241	2.1%	9757	0.1%
2001 - 4000	166	1.7%	4316	0.050%	108	1.0%	2751	0.03%	80	0.7%	1951	0.02%
4000 +	2	0.02%	86	0.001%	11	0.1%	917	0.01%	69	0.6%	976	0.01%
Total	9755	100%	8631555	100%	10824	100%	9171401	100%	11471	100%	9756760	100%

NOTE: figures do not add up due to rounding up.

SOURCE: Public Sector Organisation for the Distribution of Electrical Power, Cairo, Egypt, Annual Statistical Reports [66], several years consumption and consumer shares have increased in absolute and relative values. Due to high inflationary trends in Egypt, one has to acknowledge the fact that while the residential electricity tariff has remained unchanged throughout the three-year period, they have declined in real terms. In such a case, electricity users were being faced with a 'cheap' good whose real value was declining in contrast to the other goods available in a highly inflated economy. Thus, consumers either acquired more electrical durables or utilized more electrical power or even both, the end result being a tendency to move away from the first block which was mainly intended for basic needs of electrical power and heading towards higher consumption levels.

In fact, another significant observation can be made on examining Table (4.12). That is, the Table shows that the majority of residential electricity customers lie within the first consumption band and account for only a fraction of total residential consumption. For instance, in 1988/89, 66% of total residential customers accounted for only a quarter of residential electricity consumption in Egypt. Furthermore, the last six consumption blocks in 1988/89, correspond to only around 1% of total residential customers which account for less than 10% of total residential consumption in that year.

In this sense, one can say that there is a bias in the tariff structuring towards the majority of the customers who are consuming only a small proportion of electricity.

Increasing the number of tariff blocks makes billing and accounting more complicated for both customers and the electricity authority. Customers at the top end of the tariff blocks may be re-classified into one or more block if one accepts that they only represent a small proportion of total customers and that their consumption is also not very significant. Nonetheless, those customers who are increasing their consumption above 100 KWH/month and thus, moving to the second, third, and fourth blocks, have to be discouraged from doing so or alternatively they would have to bear the real cost of electricity and not enjoy the implicit subsidy. Finally, customers whose consumption fall below 100 KWH/month (i.e., lie within the first block), ought to have their consumption broken down further.

The objective of this exercise would be to arrive at - or at least attempt to - the basic minimum consumption level needed to satisfy the needs of the poor or low-income groups for electricity supply or even a good approximation to it. Once this has been accomplished, a further study has to be undertaken in relation to household income in order to re-identify the consumer groups who are in need for subsidised electricity prices.

In a nutshell, one of the recommendations believed to be made by this study would be to reduce the limit of the first tariff block to a level which more-or-less approximates the quantity required to sustain a basic need in most low-income households. In such a case, subsidising this first block intended for basic needs of electricity supply, would not violate its cause in the sense that it would reach those groups who it was originally designed for. In fact, under the present tarification policies, it is hard to believe that over 65% of all residential customers in Egypt are poor or of low-income and thus require implicit subsidies on their electricity consumption. Furthermore, one would suspect that their consumption may include the use of some electrical durables which may bring about wasteful consumption.

The argument presented so far suggests that electricity pricing can play a crucial part in curbing the demand for electricity as a demand management tool. Therefore, a comprehensive review of the present electricity tarification policies in Egypt is of the utmost importance if this alarming trend in consumption is to be reversed.

4.3. International comparison of residential tariffs:

So far, this Chapter has been mainly devoted to studying electricity prices in Egypt. It is of much interest to compare tariff structures in different developing countries. Table (4.13) shows different tariffs in four developing countries in 1987, Egypt, Nepal, Pakistan, and Turkey. For the purpose of comparison, all the tariff rates are shown in US cents/KWH. The same information is represented in Figure (4.2). The Table indicates that both the rates as well as the bands vary greatly between

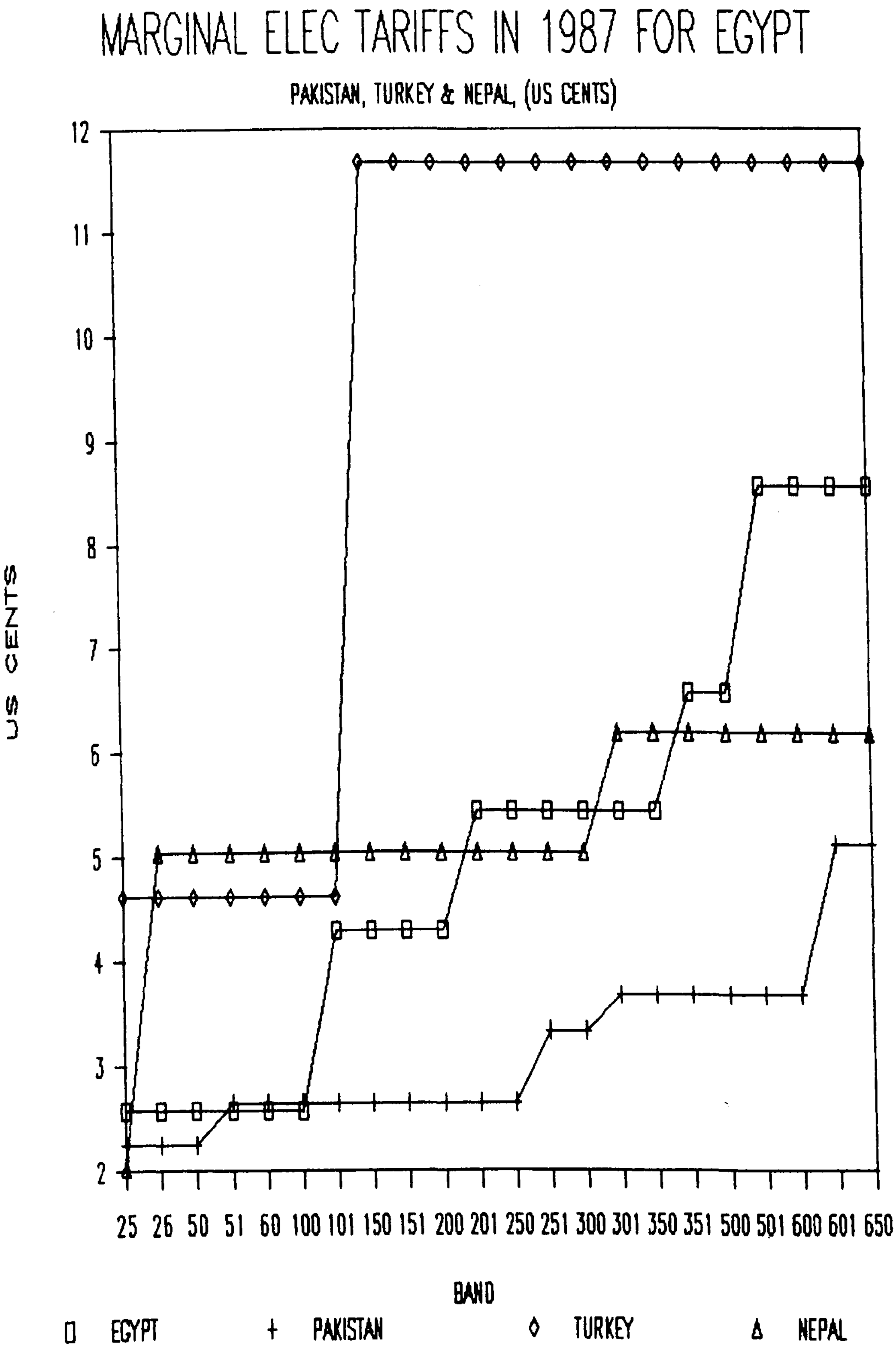
TABLE (4.13)

MARGINAL ELECTRICITY TARIFFS IN 1987
FOR EGYPT, PAKISTAN, TURKEY & NEPAL
(US CENTS)

EGYPT	BAND (KWH)	- 100	101 - 200	201 - 350	351 - 500	501 - 650
	TARIFF (US CENTS)	2.57	4.29	5.43	6.57	8.57
PAKISTAN	BAND (KWH)	- 50	51 - 250	251 - 300	301 - 600	601 +
	TARIFF (US CENTS)	2.24	2.64	3.33	3.68	5.12
TURKEY	BAND (KWH)	- 60	150 +			
	TARIFF (US CENTS)	4.61	11.67			
NEPAL	BAND (KWH)	- 25	26 - 300	300 +		
	TARIFF (US CENTS)	2.02	5.04	6.19		

SOURCE: MARKANDYA ET AL [46]

Figure (4.2)


MARGINAL ELEC TARIFFS IN 1987 FOR EGYPT
PAKISTAN, TURKEY & NEPAL, (US CENTS)
US CENTS
12
11
10
9
8
7
6
5
4
3
2
25 26 50 51 60 100 101 150 151 200 201 250 251 300 301 350 351 500 501 600 601 650
BAND
EGYPT
PAKISTAN
TURKEY
NEPAL

countries. In addition, the same Table shows that Turkey has only two bands, Nepal three, Pakistan five, and Egypt ten of which only three are represented. For over 150 KWH consumed per month, Turkey has by far the highest residential rate at 11.67 US cents/KWH while Pakistan has the lowest rate at 2.64 - 5.12 US cents/KWH. At very low levels of consumption, Nepal, Pakistan and Egypt, all provide electricity at quite favourable rates at 2.02, 2.24 and 2.57 US cents/KWH respectively. However, the range over which this rate extends is only 0 - 25 KWH in Nepal. In Pakistan, it is 0 -50 KWH and in Egypt, it is 0 - 100 KWH.

In the foregoing discussion, we have studied the actual tariff structures in four developing countries from which we can make the following remarks.

1) there is a graduated tariff structure in each case.
2) the bands vary widely among countries and have no systematic relationship to variations in consumption or to the relative income levels between countries.
3) in the case of Egypt, the tendency over time has been to freeze rates at the lower end and introduce more bands with substantially higher rates at the top end.

With regard to Egypt, we have argued previously that the various tariff structures introduced in the last decade do not satisfy the basic economic efficiency criteria. Moreover, there is no systematic reasoning for the ad hoc increases in tariff rates. In addition, what the new tariffs in Egypt have brought about beside nominal price increases is an increase in the number of tariff bands to the extent that they have reached a dramatic number of ten. In practice, the number of tariff bands are usually limited to a number between 2 and 5 bands [46]. The logic behind having fewer number of bands lies within one of the objectives of tariff setting which stipulates fewer bands in order to achieve simplification and less confusion, all of which would assist in tariff administration and better understanding of customer billing.

4.4. Electricity expenditure and household income:

In order to study actual expenditure on electricity and its other energy substitutes - most notably kerosene, as proportion of incomes per household, one has to examine the household budget survey in both rural and urban areas. Unfortunately, the most recent survey conducted in Egypt[8] was that of 1981/82 on a sample of 17,172 households, 8955 of which were urban households and 8217 rural ones. However, presenting its major findings would give us a more-or-less clear insight on energy expenditure vis-a-vis household income.

Table (4.14) reports the annual expenditure on both electricity and kerosene per urban and rural household as assigned to each income band. The same data compiled from the 1981/82 budget survey was used to relate annual electricity

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[8] It is an unpublished survey obtained through personal communication with CAPMAS [13].

TABLE (4.14)

ANNUAL ELECTRICITY & KEROSENE EXPENDITURE
PER URBAN & RURAL HH
IN EGYPT, 1981/82
(L.E.)

ANNUAL INCOME BANDS L.E.	ELECTRICITY				KEROSENE			
	URBAN		RURAL		URBAN		RURAL	
	EXPEND L.E.	SHARE (%)	EXPEND L.E.	SHARE (%)	EXPEND L.E.	SHARE (%)	EXPEND L.E.	SHARE (%)
-400	5.3	1.95	1.4	0.54	9.5	3.50	9.1	3.61
400-	10.0	1.97	4.0	0.79	10.1	1.98	10.9	2.15
600-	13.3	1.89	5.9	0.84	10.9	1.54	12.1	1.72
800-	17.1	1.89	7.8	0.87	11.8	1.31	13.6	1.52
1000-	19.3	1.76	10.2	0.93	11.6	1.06	13.9	1.27
1200-	21.9	1.69	11.4	0.88	12.7	0.98	15.1	1.17
1400-	24.3	1.63	13.1	0.88	12.4	0.83	15.4	1.03
1600-	26.9	1.51	13.3	0.75	13.1	0.74	18.7	1.05
2000-	30.0	1.25	15.9	0.66	11.5	0.48	18.3	0.76
3000-	35.6	1.03	18.5	0.55	11.3	0.33	21.7	0.64
4000-	40.5	0.83	22.5	0.46	10.0	0.21	30.1	0.61
6000-	53.1	0.66	17.0	0.21	7.7	0.10	28.9	0.36

NOTE:
SHARE DENOTES PERCENTAGE OF EXPENDITURE TO AVERAGE INCOME.

SOURCE:
COMPILED AND CALCULATED FROM AN UNPUBLISHED 1981/82 HOUSEHOLD SURVEY ACQUIRED THROUGH PERSONAL COMMUNICATION WITH CAPMAS [14]

and kerosene expenditure per household to average annual income per band and is also presented in the same Table. One can make several interesting observations by examining Table (4.14). With regard to annual household expenditure on electricity, both in urban and rural cases, there is a progressive increase as household income also increases.[9]

On calculating the expenditure elasticity, that for urban households is highly significant and equal to +0.65, while that for rural ones is quite small (of magnitude +0.11) and insignificant. This increase in electricity expenditure in abstract terms can be explained simply by the fact that as household income increases, one expects more expenditure on the same good. It may be very much the case that electricity users acquire more stock of electrical appliances as their incomes increase or may simply be just consuming more with their existing stock of electrical appliances.

Nevertheless, the magnitude of expenditure on electricity differs significantly between urban and rural households. One can attempt to explain that through the differing nature of electricity consumption patterns between the two areas in general. That is, rural households may for instance prefer other sources of energy to electricity such as butagas (LPG), dung, kerosene or fire-wood for cooking or heating. In other cases, rural households may prefer kerosene or alcohol for lighting purposes.

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[9]Except in the case of electricity expenditure in rural households of the last income band where one would expect it to assume a value above that of the band prior to it.

In any case, it is worth examining household expenditure on electricity as proportion of average income. In fact, Table (4.14) indicates that in urban households, the ratio of expenditure on electricity to average household income has declined steadily as income increased. This shows that while expenditure on electricity has increased in absolute values as household income increased, overall expenditure on electricity relative to the increase in income has declined. In brief, average household income was increasing at a much higher rate than that of household expenditure on electricity.

In rural households, however, an interesting pattern appears whereby the ratio of electricity expenditure to household income has increased from the lowest income band up to the middle when it declined. One can regard the acquisition of electrical appliances by rural households as the main cause for this trend. This argument is partly supported by the figures in Table (4.14) where the ratio of electricity expenditure to average income in rural households takes very minimal values at low incomes which increases gradually then fall again. In fact, rural electricity users in low income groups may well be consuming less of electricity and more of the other energy sources due to many reasons non of which can be founded on economic theory. One reason is related to the rural electrification programme in Egypt which was responsible for the electrification of a major part of rural areas in Egypt since the fifties.[10] However, many villagers are still not used to the concept of utilising electricity in its known uses, simply because that they were much accustomed to using the more traditional energy sources which are more accessible to (and in many cases much cheaper) than those in urban areas. Secondly, the attitude and perception towards acquiring electrical appliances is different in urban households to those rural ones. That is, many of the electrical appliances in use in urban areas as consumer necessities, are perceived to be a kind of luxury in rural areas. Thus, many of the electrical appliances in rural households would be found in those with higher income, and in many cases their use would be very much limited and thus, the whole idea of acquiring those appliances in the first place is merely an exercise of pride and prestige. In this sense, one expects - just as indicated in Table (4.14) - to find the share of electricity expenditure in average income of rural households to climb as income increases, then starts to descend same as in urban households, once expenditure on electricity increases at a rate which lags behind that of income.

However, one of the main energy rivals to electricity is kerosene especially in low-income urban households and most rural households in general. In this context, Table (4.14) indicates that expenditure on kerosene in both urban and

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[10]This programme is still in progress to date, though the Egyptian government claims that at present, there are only very few villages without electricity hook-ups.

rural households in the first two income bands, is by far the largest in contrast to those of electricity. In both cases, that is, urban and rural households, expenditure on kerosene increases in absolute values. However, this trend is reversed in higher income bands in urban households, as one expects in urban areas where households with higher incomes may switch to other energy sources. Nonetheless, this is not the case in urban households whose expenditure on kerosene escalates though there is a slight indication right at the final income band where expenditure drops from its previous level. Thus, in terms of kerosene expenditure proportional to average income, this ratio is noted from the same Table to drop in both urban and rural households though the decline is more significant in urban households than in rural ones.

To summarize the main arguments which evolved on studying Table (4.14), one can clearly assert that electricity in urban households assumes a much greater weight than in rural ones, with regard to expenditure in absolute value as well in relation to average income. Some of the reasons which are perceived to be responsible for this difference were discussed in the foregoing argument. However, since the 1981/82 household survey was conducted, one suspects that many of the consumption trends have changed and a major shift towards electricity has taken place and thus, a more updated survey is an absolute priority if the electricity authority is to study electricity consumption in relation to various income groups of society. In fact, one has to stress the need to examine the inherent relationship between expenditure on electricity and income. We were able to indicate that the expenditure elasticity of electricity in urban households is high and significant, while that in rural ones is low and insignificant whereas in Chapter 1, we estimated the income elasticity of electricity to be low and insignificant in general. In terms of tariffs, due to the differences in consumption patterns between rural and urban households, the feasibility of applying a unified nationwide electricity tariff has to be thoroughly researched.

5. Summary and conclusions:

In Egypt, the demand for electricity has been increasing at an alarming rate for over a decade. Much of the increase has been accounted for by the residential sector which exhibits a substantial deficit between its share in total consumption and that in total sales revenues in comparison to the other sectors of the economy.

We were able to demonstrate that the average annual growth of the per capita residential consumption exceeded that per residential customer implying an increasing trend in households consumption which we related to the increase in household income, the acquisition of electrical durables, and the possibility of households with fewer members. This was coupled by the fact that average electricity prices were falling well below their average costs since the seventies even on calculating the costs of fuel at their highly subsidised prices. On adjusting for inflation, this matter was aggravated further whereby electricity prices lagged behind considerably in real terms. Thus, we asserted that while the prices of the other goods and services in Egypt were increasing in real terms, that of electricity was falling and hence consumption ran at very high growth rates.

In fact, it was evident that a proportion of the residential customers were increasing their consumption levels and consequently moving from the first tariff blocks into the second and third ones. Once again, the price of electricity being unrealistically low in relation to other goods has had a direct effect on consumption levels.

Despite the attempts by the Egyptian government to increase the electricity prices successively, we have indicated that the increases were undermined by inflation, and thus, consumers of electricity were not getting the correct price signals. Nonetheless, it was clear that the majority of the customers lie within the first block whose price was seldom increased - or only by small percentage -in successive tariffs. At that point, we remarked that a further study was of utmost priority in order to determine whether those customers consumed only what is perceived necessary to satisfy basic needs or indeed whether they were to be considered a potential target group for implicit subsidy on electricity. In our opinion, the upper limit of the first block (i.e., 100 KWH) exceeds what one may define as the basic requirement although this may be highly subjective. Moreover, one may be of the opinion that not all the customers in the first tariff block need the subsidy, otherwise there would not be tendencies to move into higher tariff blocks. In any case, we believe that the first block which is perceived to shoulder the bulk of the implicit subsidy, has to be redefined in such a manner that customers would be categorised more fairly.

In general, we showed that not only were the prices of electricity declining in real terms, they did not reflect the general level of prices of the other goods and services in the economy in the sense that the latter ones were exhibiting massive inflationary tendencies. In fact, despite the successive attempts by the Egyptian authorities to increase electricity prices in recent years, price indices for other goods and services have increased quite rapidly especially those for foodstuffs. Thus, electricity prices have declined significantly in relation to prices of other goods and services. Within the same context, this decline in electricity prices has meant a reduced share in overall household expenditure for electricity.

In the final part of this Chapter, we compiled and analyzed the data contained in the most recent household budget survey conducted on both urban and rural households in Egypt in 1981/82. Part of the data collected in the survey was devoted to electricity consumption and expenditure for different income bands in both urban and rural areas. On analyzing this data set, we were able to show that tariff structuring is not perfectly designed to accommodate for the demand in urban and rural areas as we indicated that there is a fundamental difference between electricity demand and use in both areas. In fact, this has some significance with regard to the electricity subsidy granted to households in each area. That is, policy-makers have to take into consideration the varying nature of demand characteristics in those areas when attempting to design or indeed introduce some kind of subsidy in electricity use.

CHAPTER FIVE

ALTERNATIVE PRICING SCENARIOS:
WELFARE IMPLICATIONS

1. Introduction:

The previous Chapter presented a historical review of electricity tariff structures for the residential sector in Egypt. The primary objective of this Chapter is to assess the possible impacts of the Egyptian government's attempts to achieve efficiency in electricity prices by moving them upwards in fairly rapid succession. In addition, we will also shed some light on the central issue in the analysis of price changes, the issue of equity - i.e., how these costs are distributed among electricity consumers of different income groups.

The analysis is as follows: first we analyse the distribution of electricity expenditure among consumers when the more recent tariff structure is applied. Next, the distribution of residential consumers amongst various tariff blocks is analyzed. In section three, we propose various alternative tariff structures, for the residential sector, based on certain initial conditions. Section four discusses the theoretical structure required to assess the potential (net) welfare costs of these alternative tariff structures. Section five details the calculations involved in the assessment ~~as well as the~~ results and their interpretation. The sixth section discusses the potential impacts on equity and a concluding section rounds off the Chapter.

2. Electricity consumption and expenditure, 1986/87 - 1988/89:

Table (5.1) shows that the residential tariff structure is not especially targeted to cater for those less fortunate segments of the population, that is, the poor and low-income groups. This is demonstrated by the fact that the majority of the residential consumers who lie in the lower end of the tariff blocks are subsidized. The first three blocks represent a consumption share of over 82% while the rest of the blocks (i.e., seven blocks) represent about 18% only of the total electricity consumption. Considering that the marginal tariff rates of the first three blocks are much below the marginal cost (45.7 mills/KWH) implies that only 18% of total consumption is set at a rate higher than marginal cost; that is, 82% of overall residential electricity consumption is subsidised. Therefore, in order to achieve an overall equality between prices of electricity and their costs, those consuming 18% have to pay much higher rates than marginal costs so as to make up for the shortfall of prices below costs of the remaining 82% of the total residential consumption.

Table 2.4 P/49

With regard to the number of residential customers of electricity, we find that more than 97% are implicitly subsidized. Which also implies that 97% of the residential customers throughout the three-year period consumed 82% of total residential electricity consumption. Further, some of

Table (5.1)

Electricity Consumption in Residential Sector & Corresponding
Number of Customers per Consumption Block
1986/87, 1987/88 & 1988/89

Consumption Blocks KWH	1986/87 Cons'n MKWh	1986/87 Share %	1986/87 Customer Numbers	1986/87 Share %	1987/88 Cons'n MKWh	1987/88 Share %	1987/88 Customer Numbers	1987/88 Share %	1988/89 Cons'n MKWh	1988/89 Share %	1988/89 Customer Numbers	1988/89 Share %
1 - 100	2751	28.2%	5929878	68.7%	2944	27.2%	6163181	67.2%	2810	24.5%	6458975	66.2%
101 - 200	3336	34.2%	1890311	21.9%	3702	34.2%	2081908	22.7%	4026	35.1%	2234298	22.9%
201 - 350	1922	19.7%	586946	6.8%	2241	20.7%	678684	7.4%	2673	23.3%	800054	8.2%
351 - 500	615	6.3%	112210	1.3%	714	6.6%	128400	1.4%	826	7.2%	156108	1.6%
501 - 650	371	3.8%	51789	0.6%	422	3.9%	64200	0.7%	459	4.0%	58541	0.6%
651 - 800	176	1.8%	17263	0.2%	184	1.7%	18343	0.2%	172	1.5%	19514	0.2%
801 - 1000	127	1.3%	8632	0.1%	130	1.2%	9171	0.1%	138	1.2%	9757	0.1%
1001 - 2000	293	3.0%	17263	0.2%	271	2.5%	18343	0.2%	241	2.1%	9757	0.1%
2001 - 4000	166	1.7%	4316	0.050%	108	1.0%	2751	0.03%	80	0.7%	1951	0.02%
4000+	2	0.02%	86	0.001%	11	0.1%	917	0.01%	69	0.6%	976	0.01%
Total	9755	100%	8631555	100%	10824	100%	9171401	100%	11471	100%	9756760	100%

NOTE: figures do not add up due to rounding off

SOURCE: Public Sector Organisation for the Distribution of Electrical Power, Cairo, Egypt, Annual Statistical Reports [66] the subsidised consumers in the lower end of the tariff blocks are households with few members, which implies that they receive the subsidy even though their per capita income may be quite high.

As far as the design of the system is concerned, it is not clear whether the upper limit of the first tariff block represents the maximum quantity of electricity the government intended to grant to the poor segments of society for their basic needs. If this was the original intention, then this so-called life-line rate has to be below the marginal cost of supply and the difference would be an implicit subsidy. In which case, all the other marginal tariffs would have to be at least equal to (if not above) the marginal cost in order to make up for the deficit in revenues. In practice, however, although the first block receives the bulk of the subsidy, the second and third also receive a portion of the subsidy cake. Therefore, there seems to be some ambiguity in the definition of life-line rates within the tariff structure as long as the electricity authority is unable to confine the subsidy to one block.

In addition, it is quite obvious that residential customers with high consumption levels (i.e., wealthy customers) are enjoying the subsidy intended for the poor customers in the sense that they are faced with the same tariff structure as the poorer ones at the lower end of the tariff structure. In this sense, wealthy customers are only contributing a very low proportion of the costs they incur, let alone making up the deficits incurred by the subsidy.

This brings out the conflict between achieving efficiency pricing while seeking equity goals at the same time and corroborates what was mentioned in Chapter 3, that, equity objectives are not often achieved because rich consumers of electricity get the benefits of the subsidy originally intended for the poor.

3. Price increase and welfare economics, a theoretical note:

Given a choice between two different pricing policies, objective criteria are necessary to evaluate the welfare cost of each for the economy as a whole. Most policy decisions entail considerations of equity and economic efficiency; and they quite frequently entail a balancing of the two. Few policy changes are Pareto improvements; most entail at least the possibility that some consumers will be worse off.

Welfare economics provides a useful framework to systematically discuss issues of equity and efficiency. In the field of electricity also, this provides a general theoretical framework to quantify and assess the monetary effects of electricity price increases on consumption, social welfare, and efficiency. Such evaluation helps policy-makers in the formulation of their electricity tariff structuring by shedding some light on the net aggregate benefits and on the social welfare costs implied in each scenario.

Efficient prices are defined ([76], p 26) as those which lead to the highest possible level of welfare; i.e., those prices which lead to a maximum of consumer surplus plus producer surplus. As price moves towards marginal cost, both producer and consumer surplus rise until a maximum is attained and price is set equal to marginal cost.[1] Any deviation of price from marginal cost will therefore result in a reduction in total surplus [76].

Figure (5.1) illustrates this point where P_0 = Marginal cost (MC); Consumer surplus (CS) is given by the area A + B + C. while producer surplus (PS) = 0 (as is always the case when average cost equals marginal cost). If price rises to P_1, that is, above marginal cost, consumption falls to q_1. In such a situation, CS is reduced by the area B + C and PS rises by B. Even if all of the gain in PS were redistributed to the consumer, leaving PS at zero, CS is still lower than it was initially by the amount C. This triangular area C which measures the change in PS + CS is referred to as the deadweight loss. In other words, it represents the net value by which society values the decrement in consumption $q_{MC} - q_1$, a loss that can be made good by parallel taxes or transfers. On the other hand, if the price was initially below marginal cost, a similar loss would occur. Figure (5.1) illustrates this point where if the price was initially at P_2 (that is, lower than marginal cost), the deviation from pricing at marginal cost would entail a deadweight loss equal to the

[1]This point is discussed extensively in Chapter 2.

Figure (5.1)

Deadweight Loss

(Flat Rate Tariff)

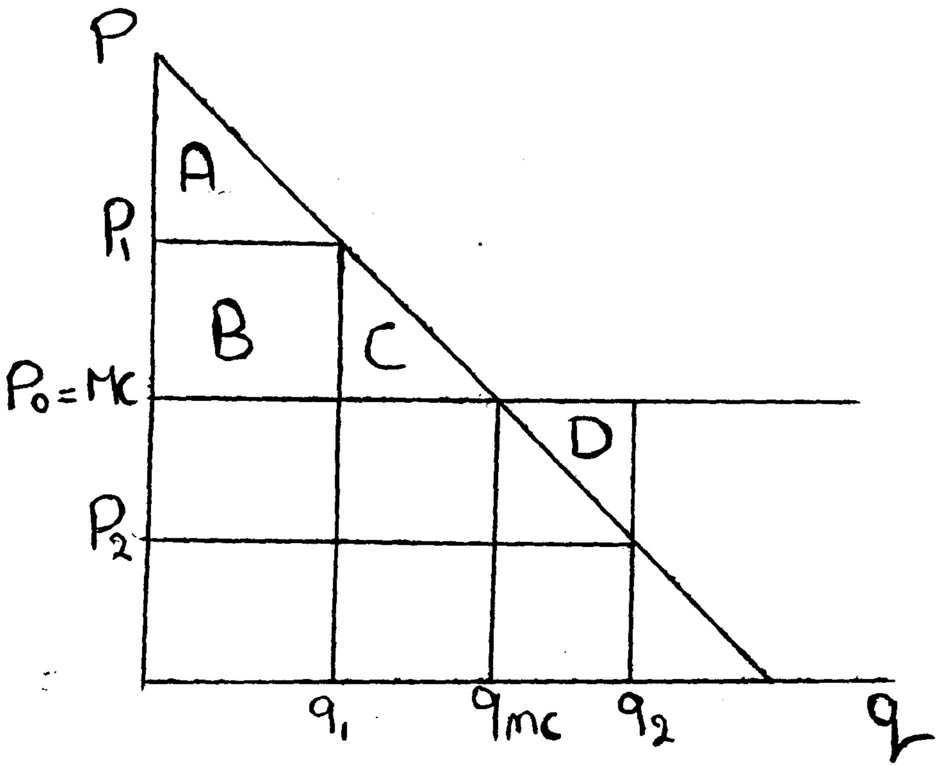
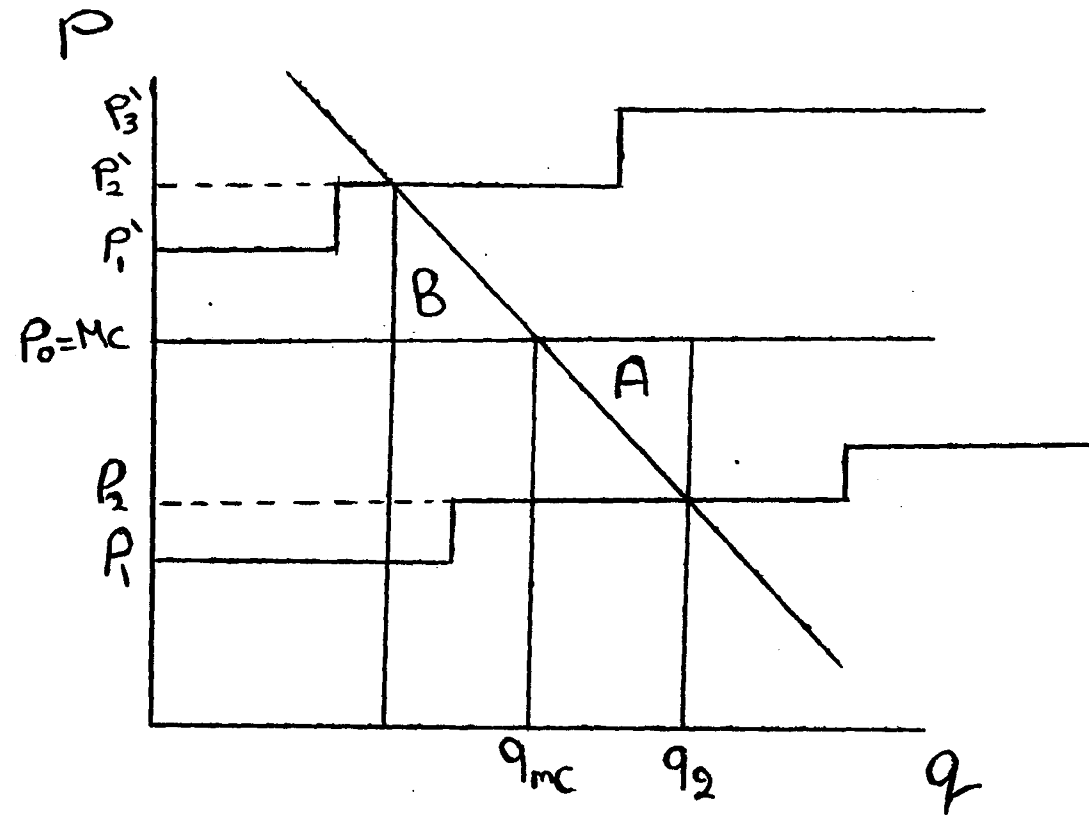


Figure (5.2)

Deadweight Loss

(Progressive Tariff)



area D.

In the case of progressive marginal tariff structure, the same analysis could be used to demonstrate the concept of deadweight loss. In Figure (5.2), once a consumer's demand curve for electricity has been estimated[2], his marginal tariff could be determined as shown in the figure. If price is increased from P_2 to P_0 (which is equal to MC), a triangle equal to the deadweight loss is obtained (area A), representing the net valuation which society places on the foregone consumption $q_{MC} - q_2$. Once again, a similar loss would occur if the marginal tariff was set initially at a level above marginal cost. This is shown in Figure (5.2) where the deviation from marginal cost, a deadweight loss would occur equal to the area B.

In fact, the change in producer surplus plus consumer surplus (known as deadweight loss) measures the cost to society of a decision not to set prices equal to marginal cost. Because producer surplus plus consumer surplus rises as price moves toward marginal cost from either direction, total surplus is maximized when price set equal to marginal cost. Any deviations of price from marginal cost can only reduce total surplus (i.e., CS + PS), so that if either the producer or consumer gains by the deviation, such a gain can only come at the expense of the other.

The first attempt for applying the concept of economic surplus to find out the welfare effects of the imposition of

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[2]Details of estimation will be given later in this Chapter.

an excise tax on consumers was by Dupuit. Marshall extended this analysis to find out its implications on both consumers and producers welfare and the effect of subsidy on also the consumers and producers welfare. The application of the concept of economic surplus was also extended to the field of public utilities. Hotelling [39] and Ruggles [71] applied this concept to measure the welfare effects of deviation from marginal cost pricing.

The deadweight loss can be depicted diagrammatically by the triangle rule, and can be calculated using the compensated demand curve (CDC). An ordinary demand curve (ODC) gives the quantity of a good that a utility maximising consumer with a given income level will demand at each price. A CDC gives the demand for a commodity under the assumption that as its price increases, the consumer is given sufficient additional income that his level of utility remains unchanged; that is, remains on the same indifference curve. If a consumer demand for the commodity remains unchanged even when the consumer is given more income (and thus compensated for the price increase), then the CDC and ODC will coincide. If the consumer spends relatively little on the good under consideration, the increase in income required to compensate him for any increase in the price will be small, and hence the CDC and ODC will not differ by very much.

When aggregating the deadweight loss of households over varying levels of income, monetary values must be interpreted with care since, as the levels of income vary from one household to another, a pound loss in welfare in one household could be dearer to a poorer one. This issue is dealt with later.

Another shortcoming of the concept of deadweight loss is that if prices in the rest of the economy are not set equal to marginal costs in all sectors apart from the one where efficiency pricing is being attempted, the private costs of expanding output in this sector (industry) will diverge from the real cost to society. Thus, if $p > mc$ in the other sectors, private costs in the efficiently priced sector will be under-stated, and over-stated if $p < mc$.

In the next section several price scenarios applied to the residential sector are presented along with measures of the welfare cost entailed by each of these scenarios.

4. Scenarios for alternative tariff structures:

Throughout the discussion presented in this thesis, we were able to show that electricity prices in Egypt - especially those of the residential sector - did not follow any systematic pattern nor did it pursue any of the basic objectives of tariff design in terms of economic efficiency. In fact, it was shown that electricity sales revenues fell short of its related marginal costs.

Two types of scenarios are considered for the residential sector: The first involves different tariff rates; while the second, uses a smaller number of tariff blocks.

4.1. Type 1 scenarios:

These scenarios are based on the following initial conditions:

Scenario 1 the rates are designed to keep the marginal tariff of the first block the same as that of the 1987 tariff structure, while the other rates are graduated in a mathematical progression with a base 14 as shown in Table (5.2). i.e., 18 page 249 in 1985 prices.

$$t_i = t_1 + (i - 1) a \qquad \text{———————(5.1)}$$

where:

t_i : the ith tariff rate,

t_1 : the lowest tariff rate, and

a : the base of the mathematical progression

Scenario 2: once again, the marginal tariff of the first block is kept the same whereas the differences between the consecutive marginal tariffs are in a mathematical progression starting with 14 and with a base 2. 18

That is,

$$d_i = d_1 + (i - 1) a \qquad \text{———————(5.2)}$$

TABLE (5.2)

TARIFF STRUCTURES OF TYPE 1 SCENARIOS
(MILLS/KWH)

SCENARIO / BLOCK	1	2	3	4	5	6	7
1 - 100	18	18	19	19	20	20	21
101 - 200	32	32	35	35	35	34	36
201 - 350	46	48	51	53	50	50	51
351 - 500	60	66	67	73	65	68	66
501 - 650	74	86	83	95	80	88	81
651 - 800	88	108	99	119	95	110	96
801 - 1000	102	132	115	145	110	134	111
1001 - 2000	116	158	131	173	125	160	126
2001 - 4000	130	186	147	203	140	188	141
4000+	144	216	163	235	155	218	156

SOURCE: DETAILS OF THE CALCULATIONS ARE GIVEN IN SECTION 4.

<u>where:</u>

d_i : the ith difference between consecutive marginal rates,

d_1 : the fixed first difference, and,

a : the base

<u>Scenario 3:</u> in this scenario, the marginal tariff of the first block will be set at 19 mills/KWH instead of 18 mills/KWH. The other rates will also be in the form of a mathematical progression[3] though with a base 16. in 1985 ?

<u>Scenario 4:</u> the marginal tariff of the first block is the same as that of scenario 3 and the differences of the other marginal rates are graduated in the form of a mathematical progression starting with 16 and with a base 2.

<u>Scenario 5:</u> in this scenario, the first marginal tariff is set equal to 20 mills/KWH. The other marginal rates are also in mathematical progression with a base 15.

<u>Scenario 6:</u> the first marginal rate is set at 20 mills/KWH similar to that of scenario 5 though with the differences in the form of a mathematical progression with the first difference set at 14 and with a base 2.

---

[3]The rates are calculated according to equation (5.1).

Scenario 7: in this scenario, we set the first marginal tariff at 21 mills/KWH and the differences are the same as those of scenario 6.

4.2. Type 2 scenarios:

In this type of scenario, we shall keep the marginal tariff of the first two blocks equal to those in the above scenarios. We will combine blocks 3 and 4 together. Similarly, we will combine blocks 5, 6 and 7 in one block. Finally, blocks 9 and 10 are also combined together. The marginal tariff of each combined block is calculated as the average of the individual marginal rates of its original blocks. Thus, the total number of blocks after reduction will be six. Table (5.3) presents the tariff structures for the different scenarios of type 2.

5. Efficiency pricing and welfare loss:

This section attempts to measure the welfare loss associated with the various tariff structure scenarios presented in the previous section. In all the scenarios of type 1 and type 2, we utilised the household survey [14] (that is, the updated set of data) which is presented in Table (5.4), in order to calculate the welfare loss, revenue (or loss), and expenditure per household and for all urban households and rural households.

TABLE (5.3)

TARIFF STRUCTURES OF TYPE 2 SCENARIOS
(MILLS/KWH)

SCENARIO / BLOCK	1	2	3	4	5	6	7
1 - 100	18	18	19	19	20	20	21
101 - 200	32	32	35	35	35	34	35
201 - 500	53	57	59	63	60	59	60
501 - 1000	88	108	99	119	95	110	111
1001 - 2000	116	158	131	173	125	160	161
2000+	137	201	155	219	147	203	204

SOURCE: DETAILS OF THE CALCULATIONS ARE GIVEN IN SECTION 4.

TABLE (5.4)

ELECTRICITY CONS IN URBAN &
RURAL HHs IN EGYPT
1988/89

INCOME GROUP	INCOME LEVEL*	URBAN CONS**	RURAL CONS**
1	26	168	89
2	52	302	171
3	72	397	249
4	90	495	320
5	110	594	382
6	130	705	440
7	150	771	624
8	178	813	698
9	240	884	779
10	332	997	884
11	487	1176	1082
12	704	1477	1263

NOTES:
* AVERAGE MONTHLY INCOME IN CURRENT L.E.
** AVERAGE HOUSEHOLD ELECTRICITY CONSUMPTION (KWH/MONTH)

SOURCE:
ACQUIRED THROUGH PERSONAL COMMUNICATION WITH CAPMAS [14]

The following equation is used in calculating the marginal cost based consumption for each income group i:

$$q_i = \alpha + \beta Y_i + \tau P_i \qquad \text{———————} (5.3)$$

<u>where:</u>

q_i : average electricity consumption per household in each income group i,

α : constant term,

β : income coefficient,

Y_i : average income per household in each group i,

τ : price coefficient, and,

P_i : = P, constant marginal cost.[4]

Most of the studies undertaken to estimate the price elasticities of electricity demand in Egypt - including our own in Chapter 1 - have indicated that these elasticities are either of the wrong sign or insignificant. Therefore, in this Chapter, we impose three different price elasticities in an attempt to investigate the effect of price elasticity on consumption and welfare loss. The price elasticity imposed will be either low of magnitude -0.2, moderate -0.5, or fully elastic at -1.0.

---

[4]This was calculated in Chapter 3 using the subsidized prices of fossil fuel as a constant value of 45.7 mills/KWH in 1986/87. We will also assume the same value in our calculations in this Chapter due to the fact that more recent data is not readily available.

We proceed by first estimating the demand parameters using the following equation:

$$q_i = \alpha + \beta Y_i \qquad \text{———————} (5.4)$$

<u>where:</u>

q_i : average electricity consumption per household in income group i,

Y_i : average income of household in group i, and,

α and β were defined previously in (5.3).

Equation (5.3) can be re-written incorporating price elasticity as

$$q_i = \alpha' + \beta' Y_i + \tau' P \qquad \text{———————} (5.5)$$

Taking averages, equations (5.4) and (5.5) can be re-stated as:

$$\bar{q}_i = \alpha + \beta \bar{Y}_i \qquad \text{———————} (5.6)$$

$$\bar{q}_i = \alpha' + \beta' \bar{Y}_i + \tau' P \qquad \text{———————} (5.7)$$

The price coefficient can now be calculated as:

$$\tau' = (\epsilon * q_i) / P_i \qquad \text{———————} (5.8)$$

$$\frac{\Delta Q}{Q} / \frac{\Delta P}{P}$$

$$\frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} \cdot \frac{Q}{P}$$

where:

ϵ : price elasticity imposed,

q_i : electricity consumption per household in group i,

P_i : marginal tariff of income group i.

Adjusting the constant term by the following expression obtained from equations (5.6) and (5.7), provided that $\beta' = \beta$:

$$\alpha' = \alpha - \tau' P_i \qquad (5.9)$$

where:

P_i : marginal tariff of income group i, and,

α and τ' were defined previously.

Due to the vast differences in average income and consumption between the upper and lower ends in both rural and urban households, the twelve income groups are divided into two parts and the demand parameters are estimated according to equation (5.4).

The estimated demand parameters for income groups 1 - 6:

Urban: $\alpha = 31.5$; $\beta = 5.2$

Rural: $\alpha = -0.98$; $\beta = 3.5$

The estimated demand parameters for income groups 7 - 12:

Urban: $\alpha = 581.9$; $\beta = 1.25$

Rural: $\alpha = 454.2$; $\beta = 1.3$

The expenditure on electricity per urban and rural household as well as their total for all the scenarios of types 1 and 2 were calculated. The expenditure for each household was calculated as:

$$\sum_{i=1}^{r} C_i \, P_i \qquad \text{———————— (5.10)}$$

<u>where:</u>

C_i : electricity consumption per household in block i,

P_i : tariff rate per block i, and,

r = 10 in scenario type 1, while = 5 in scenario type 2.

In addition, the surplus or deficit of revenues over costs were also calculated in order to assess the ability of each scenario to generate revenues. Overcost (OC) was calculated as the following:

$$OC = C_n * MC - \sum_{i=1}^{r} C_i \, P_i \qquad \text{———————— (5.11)}$$

<u>where:</u>

C_n : total household electricity consumption in group n,

MC : average marginal cost with MC pricing, and,

C_i and P_i were defined in (5.10).

The welfare loss (WL), (i.e., deadweight loss) for each household is calculated by using the triangle rule as given by the following:

$$WL = [(q_i^{mc} - q_i^*) * (P_i - MC)] /2 \qquad \text{———————}(5.12)$$

<u>where:</u>

q_i^{mc} : marginal cost based consumption per household in income group i,

q_i^* : actual electricity consumption per household in income group i, and,

P_i and MC were defined previously.

The algorithm for calculating q_i^* can be shown using Figure (5.2). That is, if P_1 (i.e., marginal tariff 1) does not intersect the demand curve, then we proceed to the next marginal tariff and so on until we determine q_i^* at a given marginal tariff.

<u>5.1. Results:</u>

Tables (5.5) and (5.6) report the total welfare loss for all scenarios of both types in urban and rural households respectively. Details of the various results are given in Appendix A5, Tables (A5.1) through (A5.84).

From both Tables, one can clearly observe that scenario 1 generates the least welfare loss among the various scenarios, not only among the three cases of price elasticities but also in both rural and urban households. On

TABLE (5.5)

TOTAL WELFARE LOSS IN URBAN HHs
FOR EACH SCENARIO
-0.2, -0.5, & -1.0 PRICE ELASTICITY
(L.E. MILLION / ANNUM)

P ELAST / SCENARIO	TYPE 1			TYPE 2		
	-0.2	-0.5	-1.0	-0.2	-0.5	-1.0
1	74	184	368	64	174	447
2	88	220	440	115	351	868
3	82	205	410	91	264	616
4	181	507	1114	145	481	1076
5	95	266	591	82	238	565
6	145	417	970	120	365	898
7	147	424	986	123	373	927

SOURCE: COMPILED FROM APPENDIX A5.

TABLE (5.6)

TOTAL WELFARE LOSS IN RURAL HHs
FOR EACH SCENARIO
-0.2, -0.5, & -1.0 PRICE ELASTICITY
(L.E. MILLION / ANNUM)

P ELAST / SCENARIO	TYPE 1			TYPE 2		
	-0.2	-0.5	-1.0	-0.2	-0.5	-1.0
1	28	80	189	26	66	183
2	50	141	358	45	115	384
3	40	112	272	37	104	258
4	64	201	451	58	185	471
5	36	99	234	34	95	237
6	52	147	373	46	132	400
7	54	160	381	48	146	408

SOURCE: COMPILED FROM APPENDIX A5.

the other hand, the same Tables also indicate that scenario 4 yields the highest welfare loss in rural and urban households.

However, while the welfare loss realized by scenario 1 is the smallest, the Tables in Appendix A5 indicate that the this particular tariff structure (i.e., scenario 1) would also yield an overall surplus in revenues (which would however be the lowest among the other scenarios). Thus, it appears that scenario 1 would not only entail the least overall loss in welfare, but would also realise a surplus in revenue. Such a surplus is considered an integral part of the electricity sector's financial viability. In fact, the realisation of surplus - as we have indicated previously in Chapter 2 - is deemed necessary for the finance of new investments in generation facilities, without having to rely on any government grant or subsidy (which may jeopardise the authority's autonomy).

However, with regard to consumption levels among households, there is quite a significant consequence to determining demand according to marginal cost. Tables (A5.1) to (A5.84) indicate that if consumers are compared according to their marginal tariffs, there are two distinct groups of households; those facing marginal tariffs below marginal cost, and others whose marginal tariffs are well above marginal cost.

If the first group of households is to adjust their consumption levels according to marginal cost (as well as their incomes), there would be a reduction in consumption. The magnitude of such reduction in consumption would, however, depend on the price elasticity; the higher the elasticity, the bigger the level of consumption that would have to be foregone by residential customers. In fact, it is shown in rural households that at price elasticity equal to -1.0, consumers in the first income group will have to go without electricity entirely; in other words, they would have to substitute electricity for another source of energy such as kerosene.

On the other hand, the second group of households (whose marginal tariffs are above marginal cost), would clearly enjoy a bigger share of consumption if they were to consume according to marginal cost. This outcome has serious implications for the equality between the two groups of consumers, which will be discussed further in the next section.

To summarize, Tables (5.5) and (5.6) indicate that scenario 1 entails the lowest welfare loss, the lowest level of expenditure on residential consumers and also realises a revenue over cost. However, consumers facing marginal tariffs below marginal cost would lose out in terms of foregone consumption.

6. Efficiency and equity considerations:

Efficiency is not the only consideration in electricity pricing. Electricity has also to be provided at prices which people can afford. This is a serious consideration in government policy-making since raising these prices has serious political implications. Sometimes, lower electricity prices in developing countries are justified on the grounds that they promote both equity (e. g., to help small farmers) as well as efficiency (for instance, to encourage use of ground water for raising agricultural output).

In the analysis of the welfare loss entailed by efficiency pricing, it should be pointed out that while we have recommended the application of the tariff structure which yields the lowest overall welfare loss, we have not considered the differential impact of this loss on households with varying incomes (whereby a pound's loss to one household is valued differently by another household with a different income). Nonetheless, we have mentioned that the welfare loss depends primarily on two factors: the price elasticity and the magnitude of the marginal tariff differential (i.e., from marginal cost). By looking at the Tables in Appendix A5, it is clear that the loss is progressive except in the cases where the marginal tariff is more-or-less equal to marginal cost (and where the loss becomes equal to zero).

However, one indication of the loss entailed by any of the price scenarios would be given by the extent by which consumption across households with different incomes would be affected by marginal cost pricing. Given this, one would be inclined to adopt a measure which would indicate the extent by which consumers across the board have to alter their consumption levels. In other words, should evaluate the losses or gains in consumption implied by the application of marginal cost pricing amongst the households with various income levels.

One measure is the percentage by which consumers would have to forego (or indeed, gain) in consumption in proportion to their actual consumption levels before the introduction of marginal cost. Figures (5.3) - (5.14) depict this ratio for scenario 1, of both types, in urban and rural households. The same analysis could be extended to investigate the change in consumption with respect to marginal cost pricing to include the other scenarios. The aim of this exercise is to investigate the extent by which demand would change according to the different tariff structures. Furthermore, it would indicate to the policy-maker the consumer groups who would lose-out (or gain) in terms of consumption through the application of any tariff structure.

Finally, we should emphasis the necessity for the policy-maker to consider the feasibility of applying any of the scenarios according to the priorities he might be pursuing. That is, not only would the application of one particular tariff structure entail a welfare loss in any

Figure (5.3)

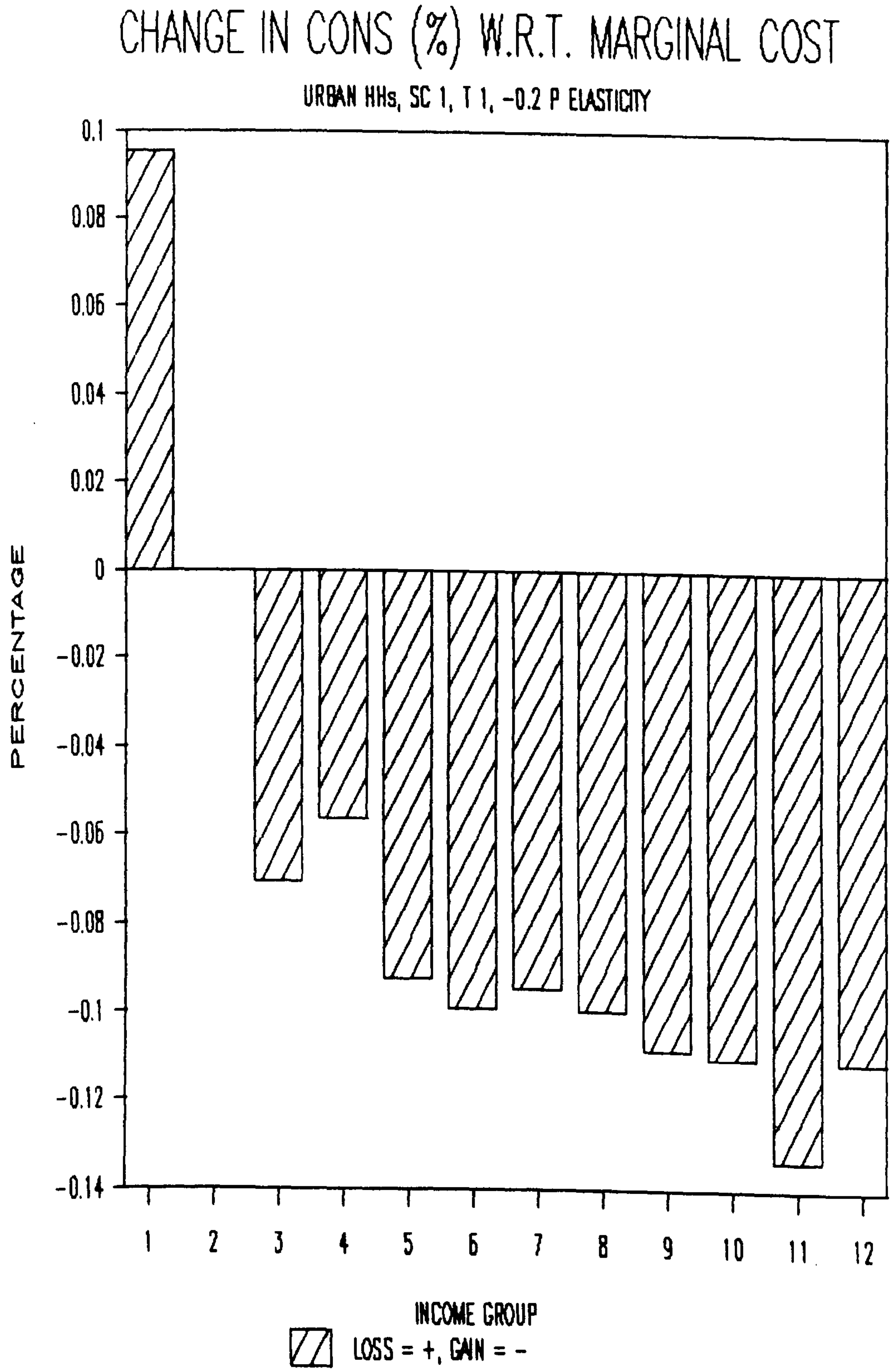

CHANGE IN CONS (%) W.R.T. MARGINAL COST
URBAN HHs, SC 1, T 1, -0.2 P ELASTICITY
PERCENTAGE
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
-0.14
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.4)

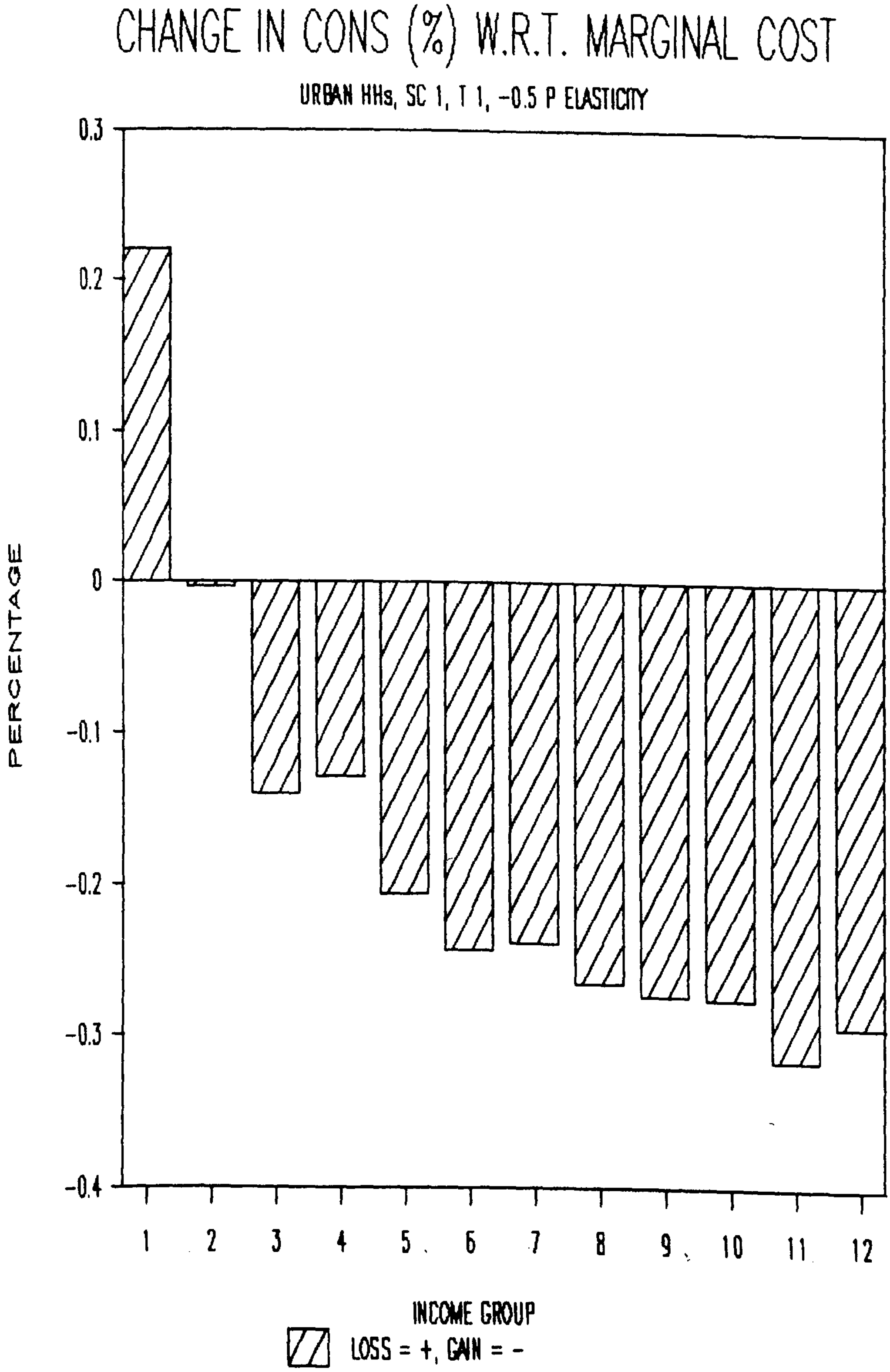

CHANGE IN CONS (%) W.R.T. MARGINAL COST
URBAN HHs, SC 1, T 1, -0.5 P ELASTICITY
PERCENTAGE
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.5)

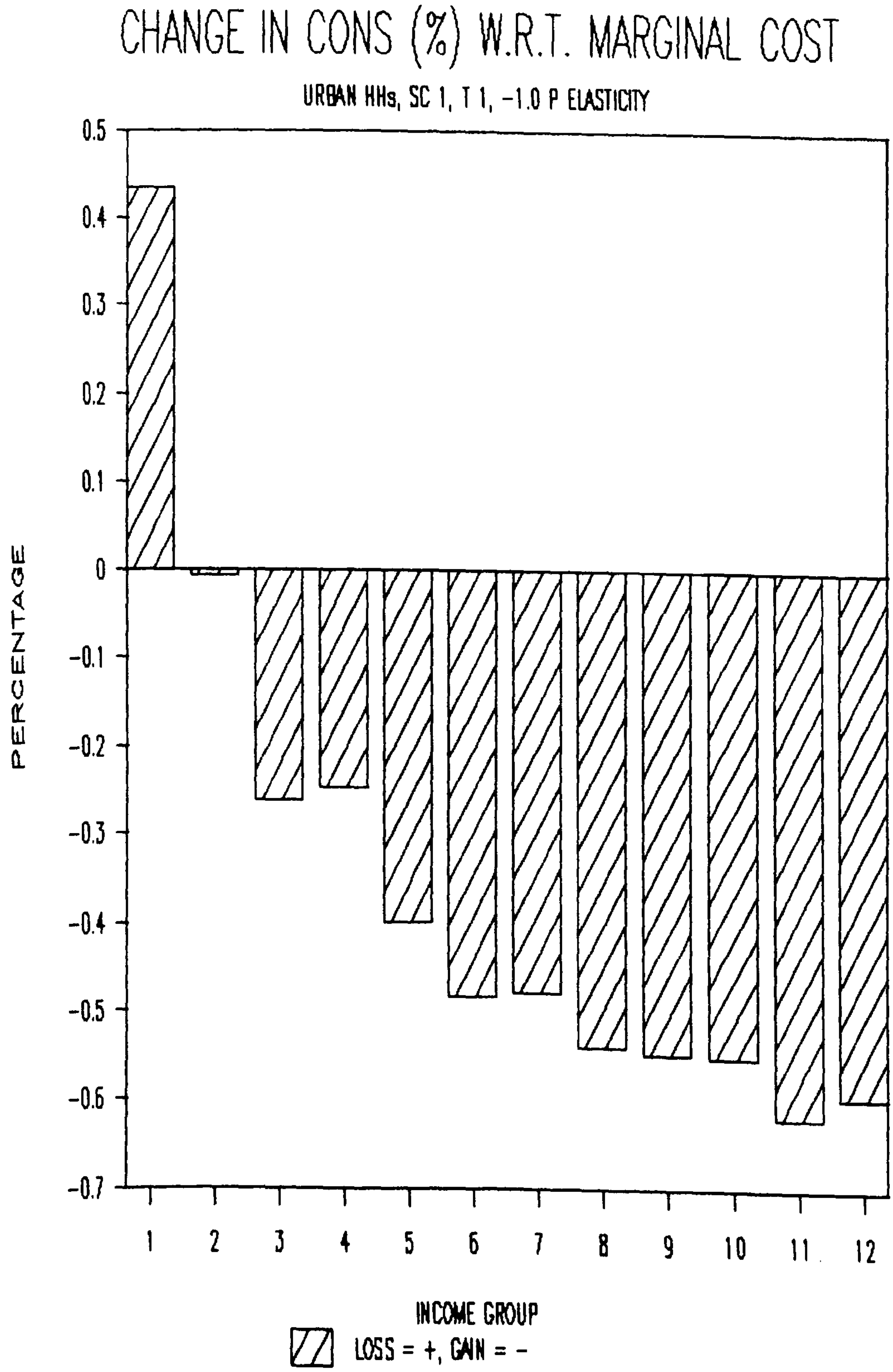

CHANGE IN CONS (%) W.R.T. MARGINAL COST
URBAN HHs, SC 1, T 1, -1.0 P ELASTICITY
PERCENTAGE
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.6)

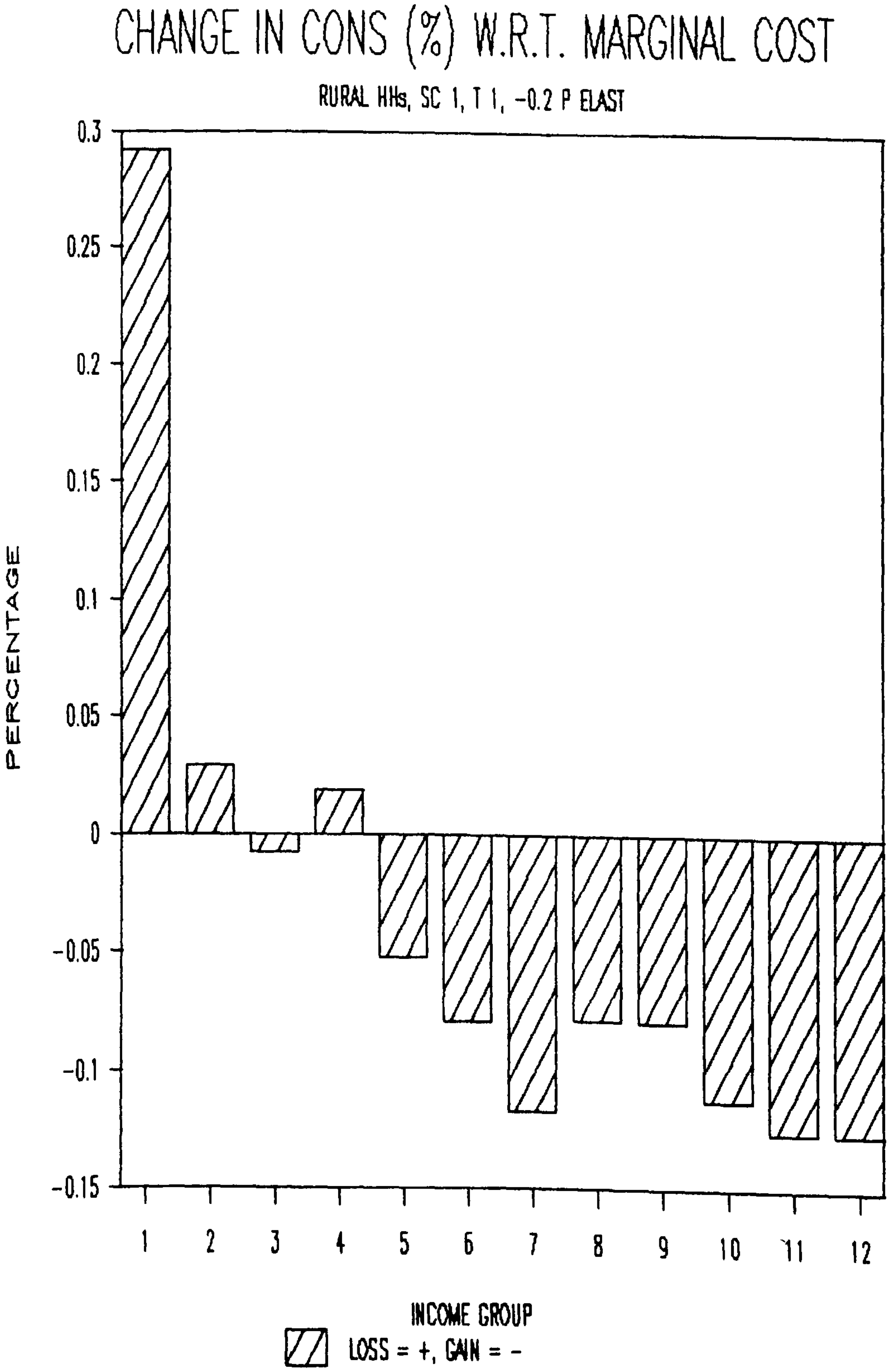

CHANGE IN CONS (%) W.R.T. MARGINAL COST
RURAL HHs, SC 1, T 1, -0.2 P ELAST
PERCENTAGE
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.7)

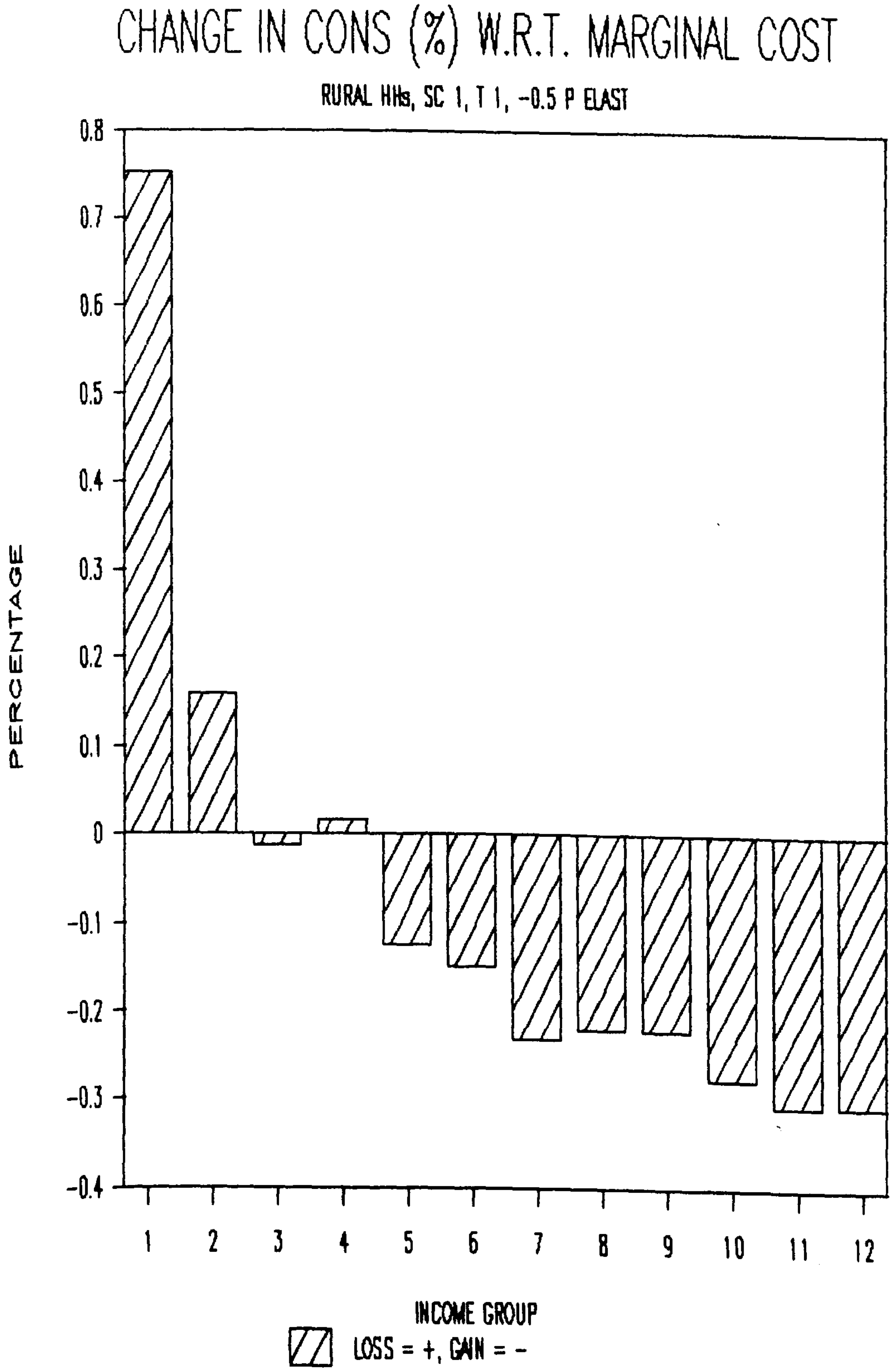

CHANGE IN CONS (%) W.R.T. MARGINAL COST
RURAL HHs, SC 1, T 1, -0.5 P ELAST
PERCENTAGE
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.8)

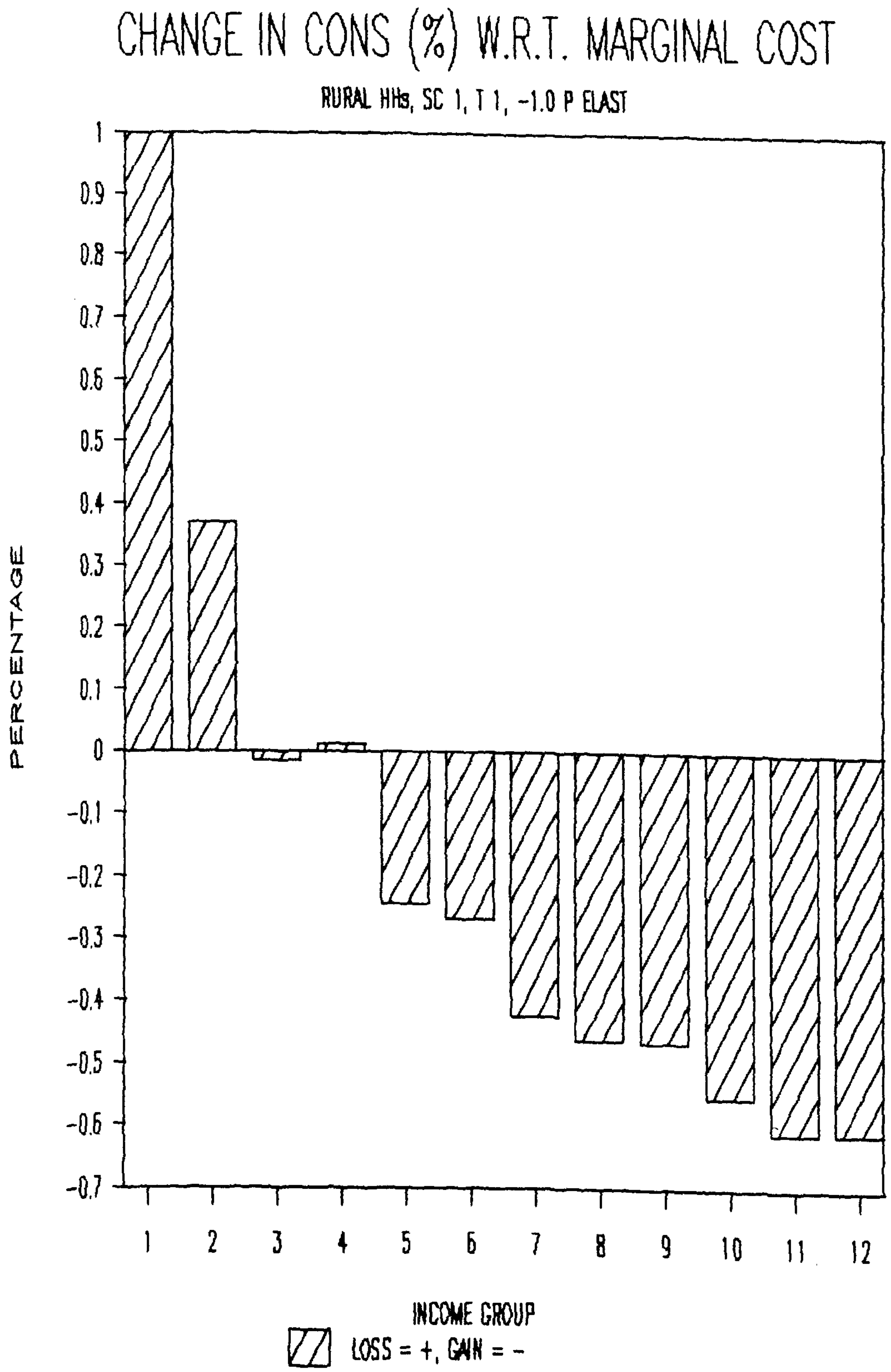

CHANGE IN CONS (%) W.R.T. MARGINAL COST
RURAL HHs, SC 1, T 1, -1.0 P ELAST
PERCENTAGE
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.9)

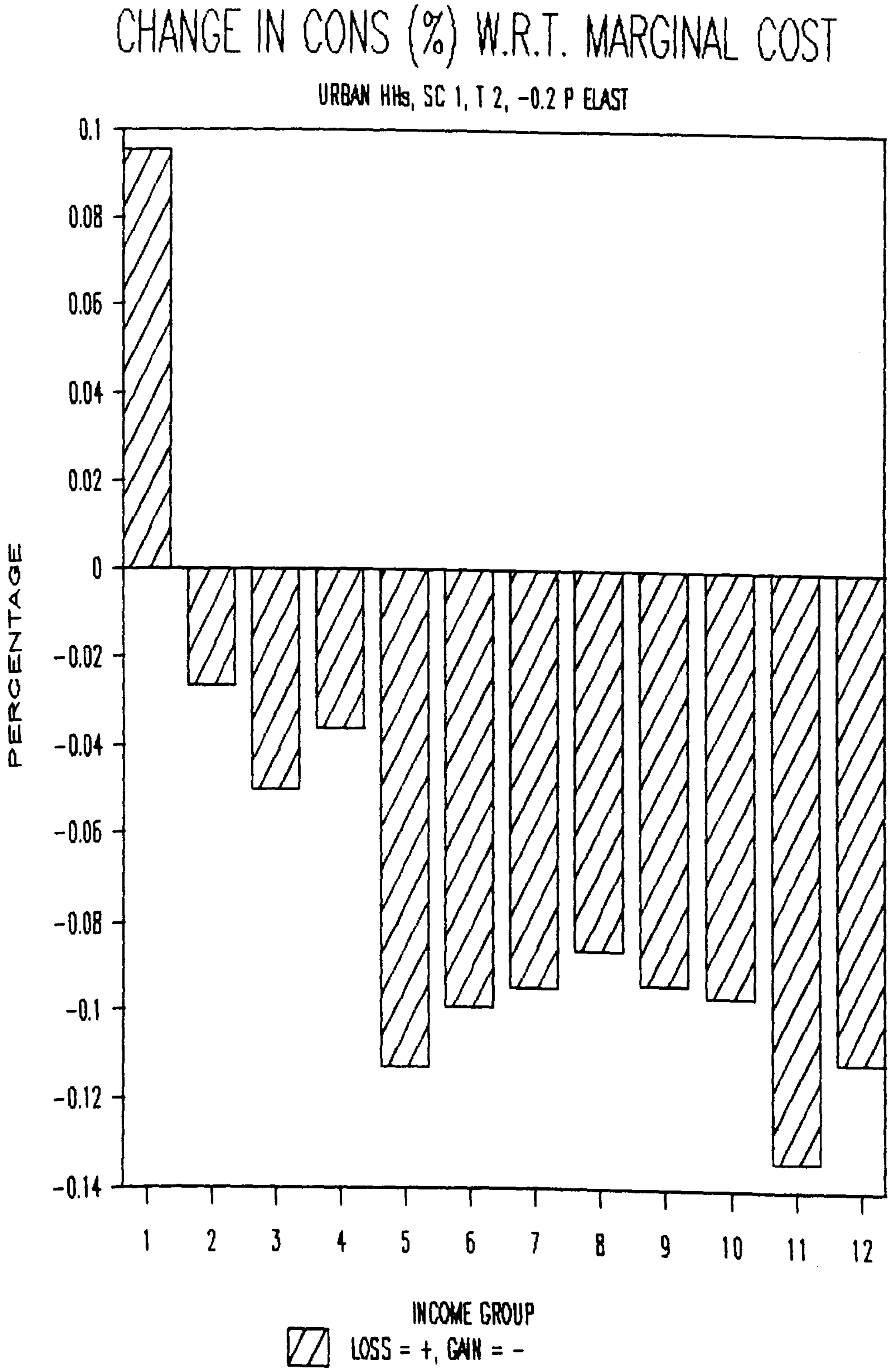

CHANGE IN CONS (%) W.R.T. MARGINAL COST
URBAN HHs, SC 1, T 2, -0.2 P ELAST
PERCENTAGE
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-0.12
-0.14
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.10)

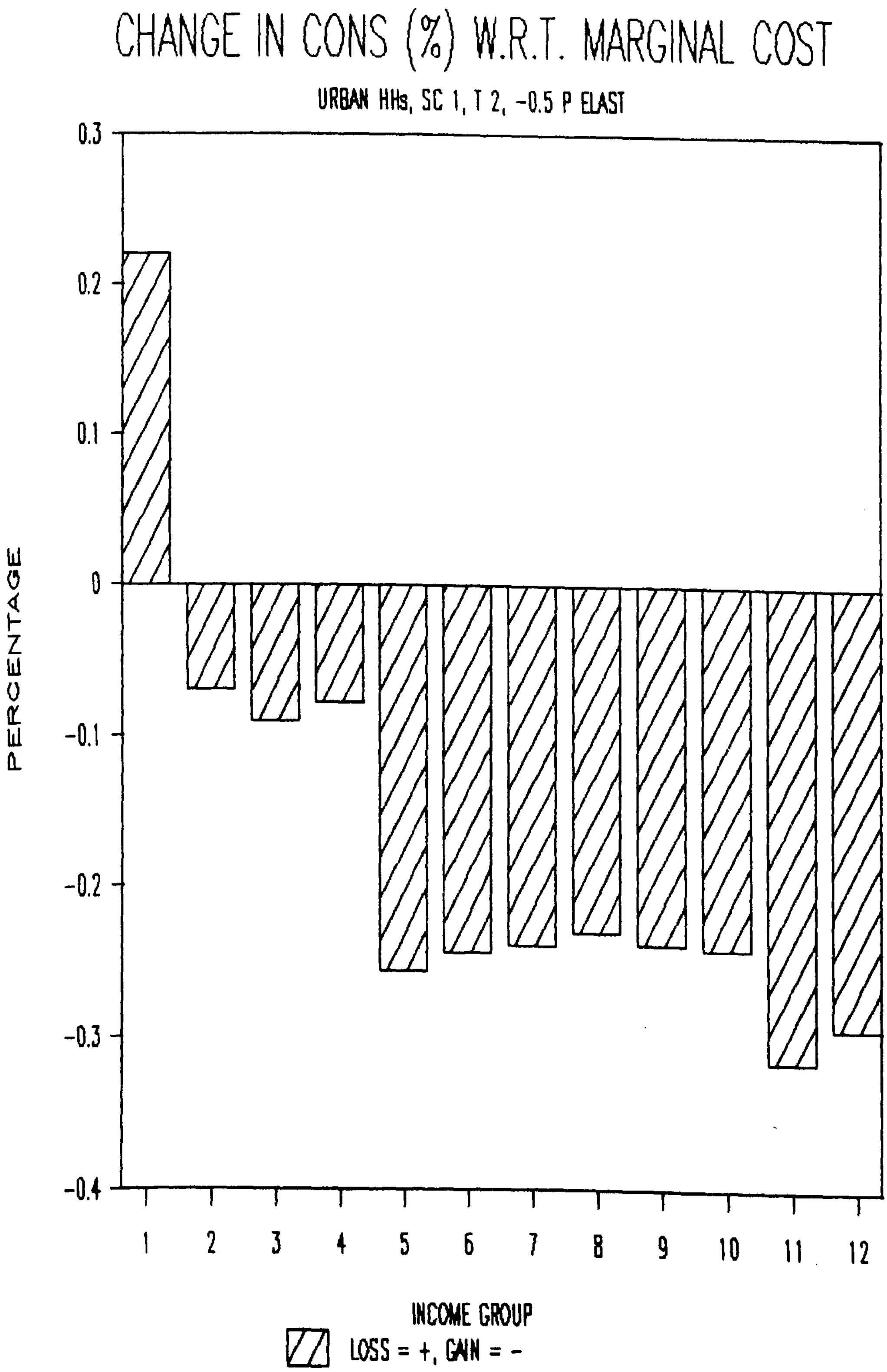

CHANGE IN CONS (%) W.R.T. MARGINAL COST
URBAN HHs, SC 1, T 2, -0.5 P ELAST
PERCENTAGE
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.11)

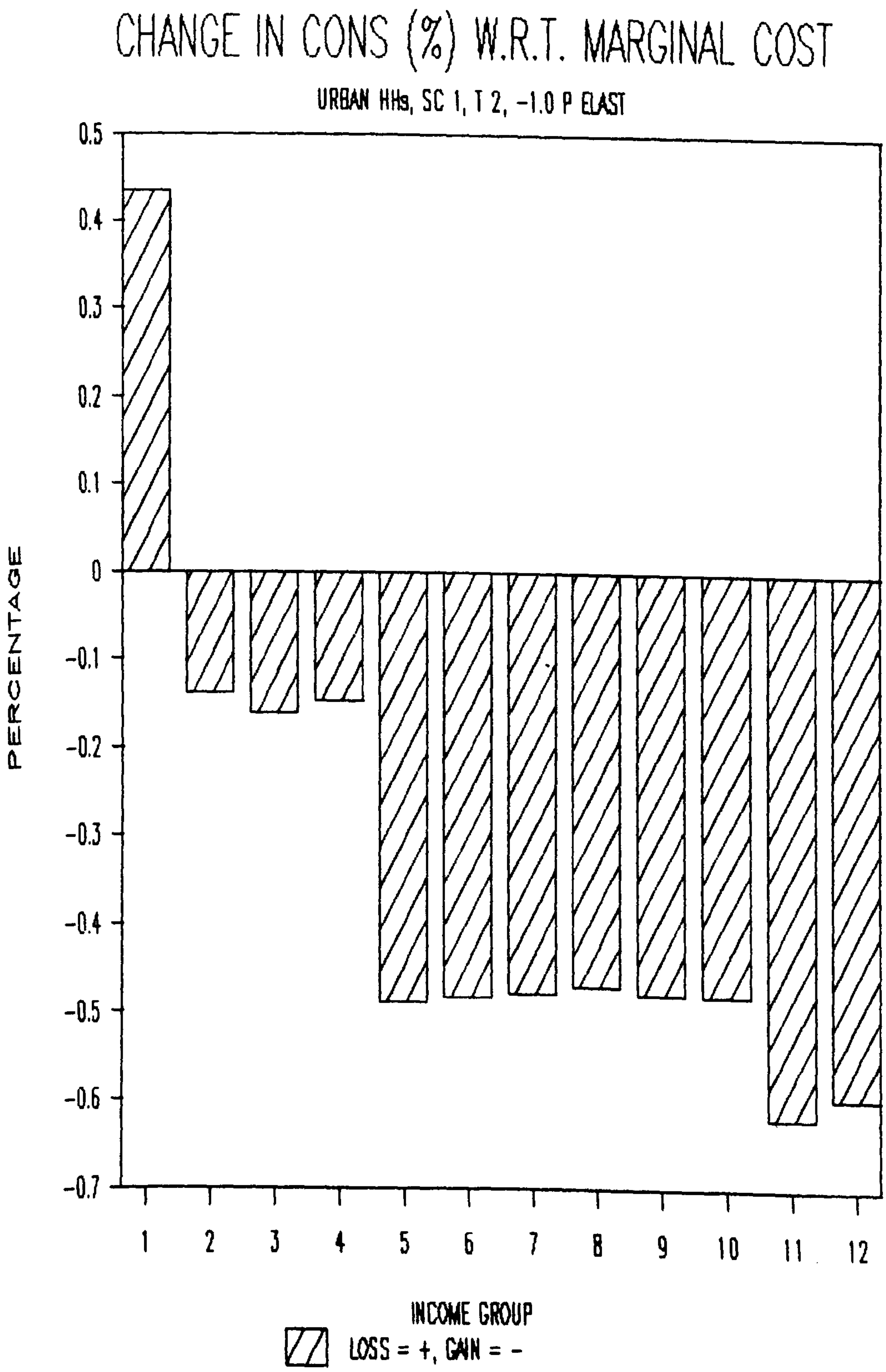

CHANGE IN CONS (%) W.R.T. MARGINAL COST
URBAN HHs, SC 1, T 2, -1.0 P ELAST
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
PERCENTAGE
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.12)

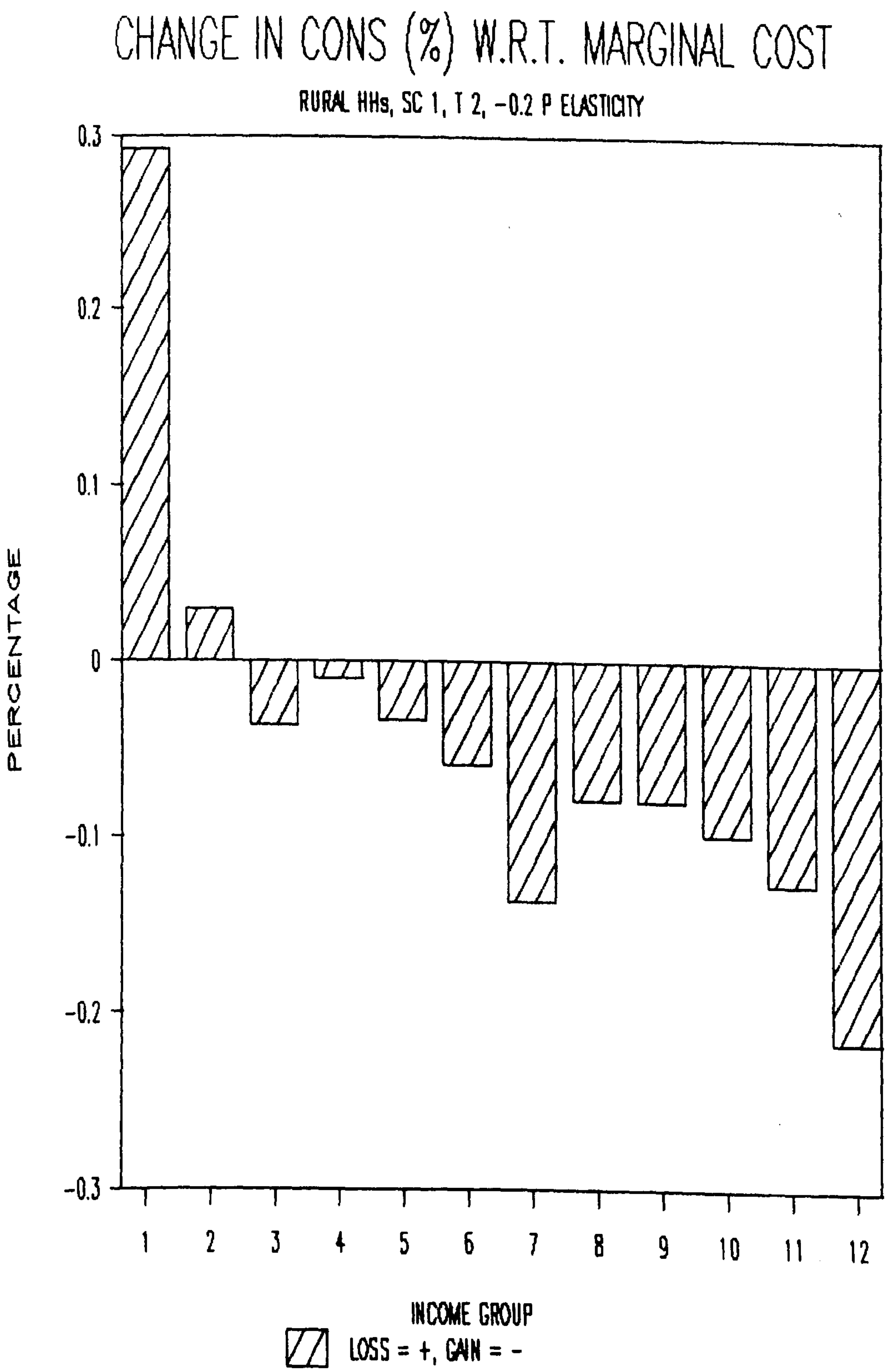

CHANGE IN CONS (%) W.R.T. MARGINAL COST
RURAL HHs, SC 1, T 2, -0.2 P ELASTICITY
PERCENTAGE
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.13)

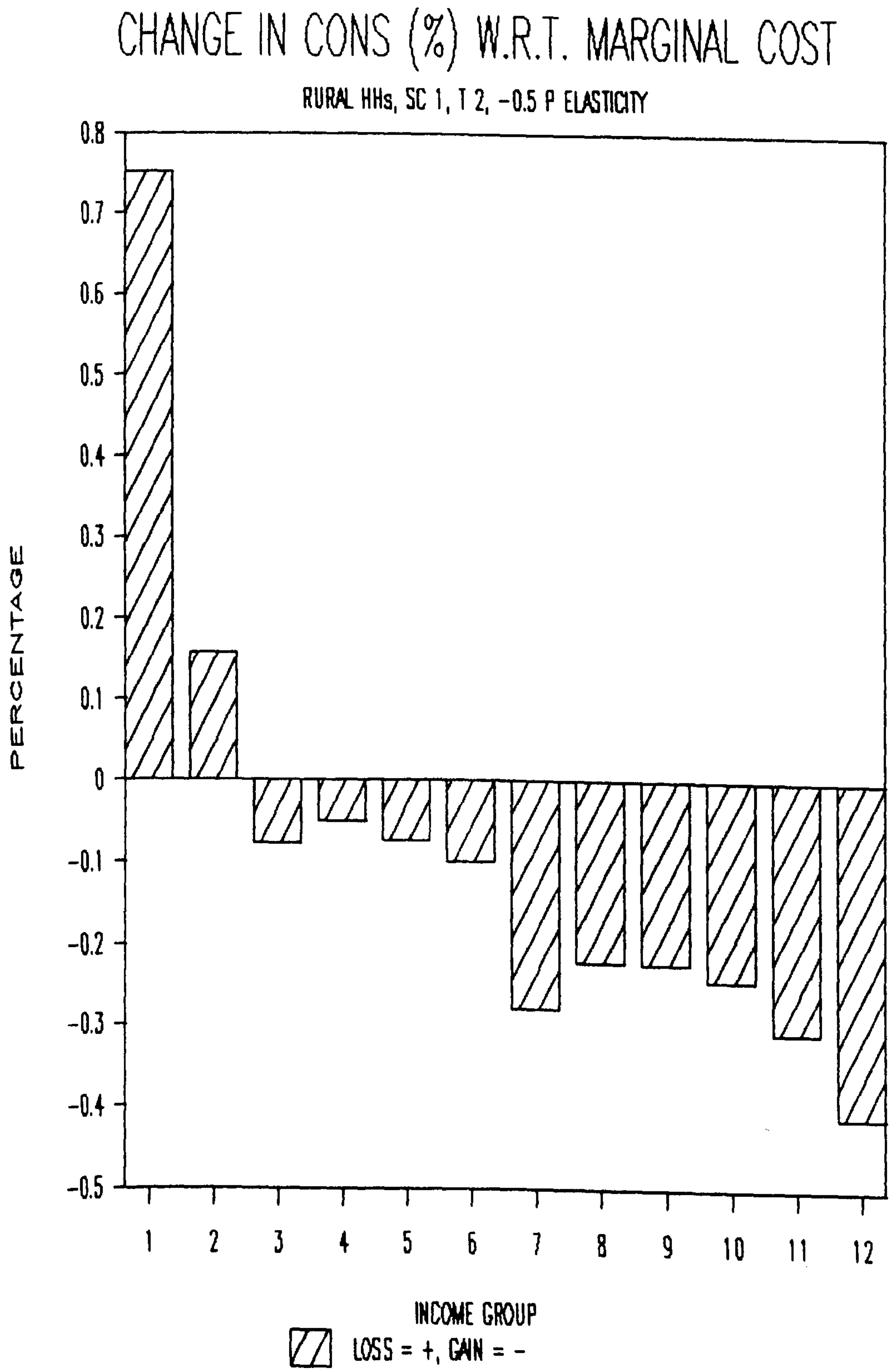
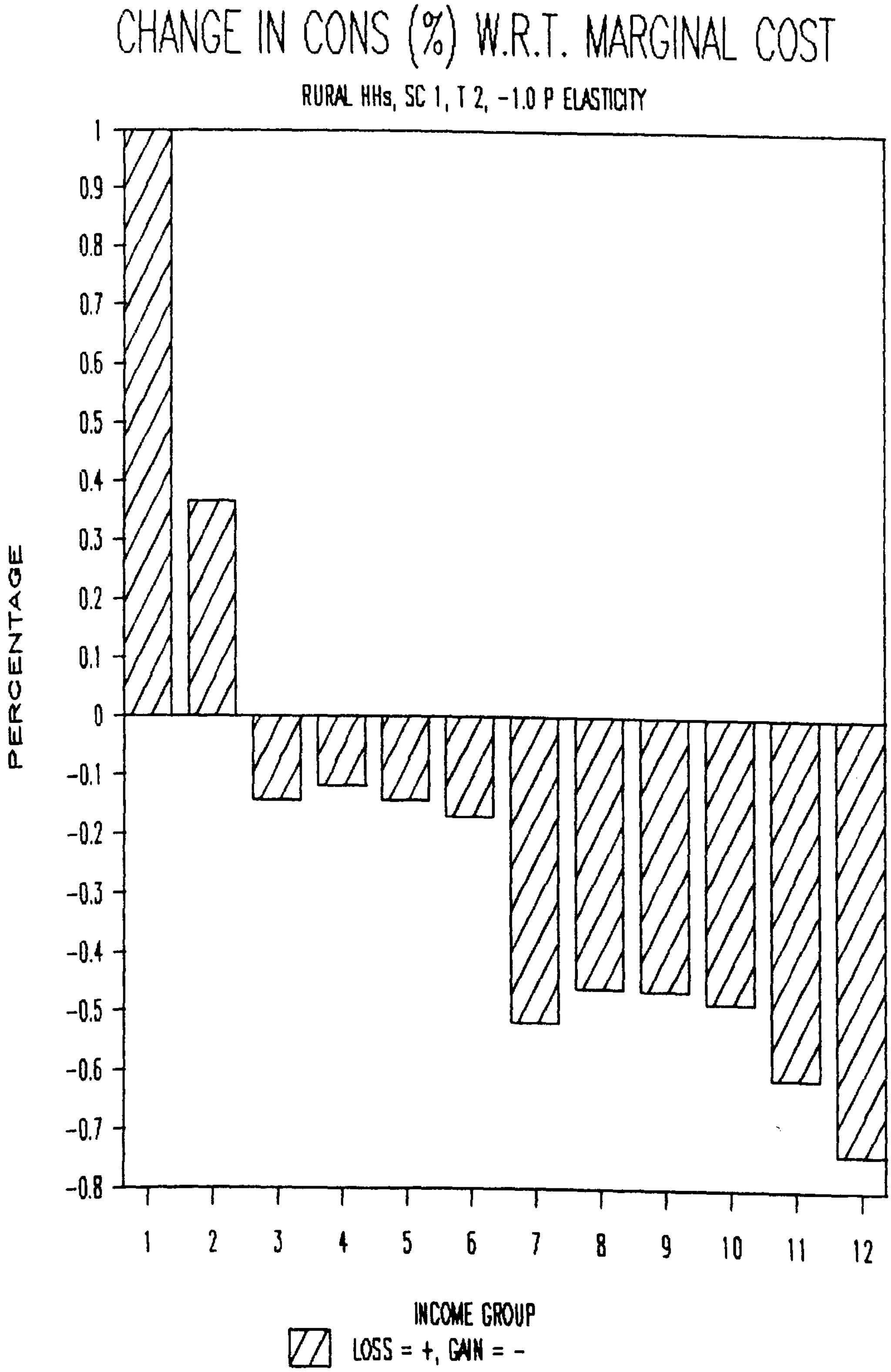

CHANGE IN CONS (%) W.R.T. MARGINAL COST
RURAL HHs, SC 1, T 2, -0.5 P ELASTICITY
PERCENTAGE
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
1
2
3
4
5
6
7
8
9
10
11
12
INCOME GROUP
LOSS = +, GAIN = -

Figure (5.14)


CHANGE IN CONS (%) W.R.T. MARGINAL COST
RURAL HHs, SC 1, T 2, -1.0 P ELASTICITY
PERCENTAGE
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
1 2 3 4 5 6 7 8 9 10 11 12
INCOME GROUP
LOSS = +, GAIN = -

case[5], those consumers facing marginal tariffs below marginal cost would have to forego more-preferred consumption as well. This outcome renders the decision-making process more political than economic. Thus the political repercussions of any price increase would have to be evaluated before the economic feasibility is assessed.

7. Summary and conclusions:

This Chapter showed that electricity prices in Egypt are not only highly subsidised, but that the tariff structures in place are also realising a net deficit overall. That is, the present and past tariff policies in Egypt do not meet the criteria of economic efficiency in the sense that total consumer expenditure (and government revenue) does not cover the total marginal costs of electricity supply. In fact, richer consumers with high levels of consumption were not being charged adequately in that this revenue did not cover the cost of subsidizing the electricity consumption of lower income groups. Various scenarios of tariff structures for residential electricity consumption were presented (in this Chapter) and the welfare loss implied by each tariff structure was evaluated. But not only were the costs entailed by the deviation from marginal cost in each tariff structure (i.e., the welfare loss) measured, but the effect of these pricing scenarios on consumption, expenditure and revenue

[5]As long as marginal tariffs deviate from marginal cost.

were assessed in addition.

On the basis of this analysis, we recommend the application of the pricing scenario that yields the least overall welfare loss and which also realises a revenue over costs. However, it must be pointed out that in all the pricing scenarios, some consumers would have to forego some (if not all) of their present consumption levels, while others would gain higher consumption levels.

In the final analysis, however, policy-makers have to choose the required tariff structure since electricity pricing has rather serious political consequences. What this Chapter has presented is a methodology that policy-makers could use in order to assess the impact of various tariff structures on social welfare and equity.

APPENDIX A5

TABLES (A5.1) - (A5.84)

TABLE (A5.1)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 1, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	18	32	46	60	74	88	102	116	130	144

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	52	0	0	0	0	0	0	0	0	152	32	42	7	42	7	168	1.3	0.2
2	52	245	100	100	102	0	0	0	0	0	0	0	302	46	116	29	49	12	302	0.0	0.0
3	72	439	100	100	150	75	0	0	0	0	0	0	425	60	197	86	36	16	397	2.4	1.1
4	90	581	100	100	150	150	23	0	0	0	0	0	523	74	271	157	16	9	495	4.8	2.8
5	110	593	100	100	150	150	149	0	0	0	0	0	649	74	383	227	-27	-16	594	9.3	5.5
6	130	568	100	100	150	150	150	125	0	0	0	0	775	88	516	293	-91	-52	705	17.8	10.1
7	150	538	100	100	150	150	150	150	44	0	0	0	844	102	596	320	-133	-72	771	24.7	13.3
8	178	482	100	100	150	150	150	150	94	0	0	0	894	102	657	317	-167	-81	813	27.4	13.2
9	240	456	100	100	150	150	150	150	180	0	0	0	980	102	763	348	-225	-103	884	32.4	14.8
10	332	133	100	100	150	150	150	150	200	107	0	0	1107	116	936	125	-329	-44	997	46.4	6.2
11	487	69	100	100	150	150	150	150	200	333	0	0	1333	116	1251	86	-520	-36	1176	66.2	4.6
12	704	34	100	100	150	150	150	150	200	641	0	0	1641	116	1679	58	-780	-27	1477	69.2	2.4
TOTAL																2053		-385			74

ABBREVIATIONS:

IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.2)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 1, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	18	32	46	60	74	88	102	116	130	144

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	31	0	0	0	0	0	0	0	0	131	32	34	6	38	6	168	3.0	0.5
2	52	245	100	100	103	0	0	0	0	0	0	0	303	46	117	29	49	12	302	0.0	0.0
3	72	439	100	100	150	103	0	0	0	0	0	0	453	60	217	95	31	14	397	4.8	2.1
4	90	581	100	100	150	150	59	0	0	0	0	0	559	74	303	176	3	2	495	10.9	6.3
5	110	593	100	100	150	150	150	67	0	0	0	0	717	74	455	270	-62	-37	594	20.9	12.4
6	130	568	100	100	150	150	150	150	77	0	0	0	877	88	637	361	-156	-88	705	43.7	24.8
7	150	538	100	100	150	150	150	150	155	0	0	0	955	102	732	394	-208	-112	771	62.2	33.4
8	178	482	100	100	150	150	150	150	200	29	0	0	1029	102	828	399	-263	-127	813	73.0	35.1
9	240	456	100	100	150	150	150	150	200	126	0	0	1126	102	963	439	-345	-157	884	81.7	37.3
10	332	133	100	100	150	150	150	150	200	272	0	0	1272	116	1166	155	-468	-62	997	116.0	15.5
11	487	69	100	100	150	150	150	150	200	547	0	0	1547	116	1549	107	-700	-48	1176	156.5	10.8
12	704	34	100	100	150	150	150	150	200	910	0	0	1910	116	2054	71	-1006	-35	1477	182.6	6.3
TOTAL																2500		-632			184

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.3)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 1, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	18	32	46	60	74	88	102	116	130	144

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	95	31	0	0	0	0	0	0	0	0	95	32	32	5	20	3	168	6.0	1.0
2	52	245	100	100	104	0	0	0	0	0	0	0	304	46	117	29	49	12	302	0.0	0.0
3	72	439	100	100	150	150	1	0	0	0	0	0	501	60	251	110	24	11	397	8.9	3.9
4	90	581	100	100	150	150	118	0	0	0	0	0	618	74	251	146	88	51	495	20.9	12.1
5	110	593	100	100	150	150	150	150	31	0	0	0	831	74	447	265	9	5	594	40.2	23.9
6	130	568	100	100	150	150	150	150	200	46	0	0	1046	88	718	408	-144	-82	705	86.5	49.1
7	150	538	100	100	150	150	150	150	200	140	0	0	1140	102	849	456	-224	-120	771	124.6	67.0
8	178	482	100	100	150	150	150	150	200	253	0	0	1253	102	1006	485	-319	-154	813	148.6	71.6
9	240	456	100	100	150	150	150	150	200	370	0	0	1370	102	1169	533	-418	-190	884	164.2	74.8
10	332	133	100	100	150	150	150	150	200	547	0	0	1547	116	1415	189	-567	-76	997	232.0	30.9
11	487	69	100	100	150	150	150	150	200	903	0	0	1903	116	1911	131	-867	-60	1176	306.6	21.1
12	704	34	100	100	150	150	150	150	200	1000	357	0	2357	116	3160	109	-1867	-64	1477	371.2	12.8
TOTAL																2865		-664			368

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.4)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 1, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	18	32	48	66	86	108	132	158	186	216

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	52	0	0	0	0	0	0	0	0	152	32	42	7	42	7	168	1.3	0.2
2	52	245	100	100	105	0	0	0	0	0	0	0	305	46	120	30	47	11	302	0.0	0.0
3	72	439	100	100	150	80	0	0	0	0	0	0	430	60	210	92	26	11	397	2.8	1.2
4	90	581	100	100	150	150	30	0	0	0	0	0	530	74	296	172	-6	-3	495	5.9	3.4
5	110	593	100	100	150	150	150	9	0	0	0	0	659	74	432	256	-70	-42	594	11.0	6.5
6	130	568	100	100	150	150	150	139	0	0	0	0	789	88	600	341	-167	-95	705	21.3	12.1
7	150	538	100	100	150	150	150	150	58	0	0	0	858	102	706	380	-236	-127	771	29.4	15.8
8	178	482	100	100	150	150	150	150	111	0	0	0	911	102	790	381	-291	-140	813	33.1	15.9
9	240	456	100	100	150	150	150	150	198	0	0	0	998	102	928	423	-381	-174	884	38.5	17.6
10	332	133	100	100	150	150	150	150	200	127	0	0	1127	116	1172	156	-554	-74	997	54.8	7.3
11	487	69	100	100	150	150	150	150	200	358	0	0	1358	116	1610	111	-865	-60	1176	76.8	5.3
12	704	34	100	100	150	150	150	150	200	672	0	0	1672	116	2205	76	-1288	-44	1477	82.3	2.8
TOTAL																2423		-728			88

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.5)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 1, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	18	32	48	66	86	108	132	158	186	216

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	31	0	0	0	0	0	0	0	0	131	32	34	6	38	6	168	3.0	0.5
2	52	245	100	100	109	0	0	0	0	0	0	0	309	46	123	30	47	11	302	0.0	0.0
3	72	439	100	100	150	117	0	0	0	0	0	0	467	60	239	105	17	7	397	6.0	2.6
4	90	581	100	100	150	150	76	0	0	0	0	0	576	74	344	199	-28	-16	495	13.8	8.0
5	110	593	100	100	150	150	150	93	0	0	0	0	743	74	541	321	-133	-79	594	25.3	15.0
6	130	568	100	100	150	150	150	150	111	0	0	0	911	88	790	449	-291	-165	705	52.3	29.7
7	150	538	100	100	150	150	150	150	192	0	0	0	992	102	919	494	-375	-201	771	74.7	40.1
8	178	482	100	100	150	150	150	150	200	70	0	0	1070	102	1064	512	-477	-230	813	86.8	41.8
9	240	456	100	100	150	150	150	150	200	171	0	0	1171	102	1255	572	-613	-280	884	96.9	44.2
10	332	133	100	100	150	150	150	150	200	323	0	0	1323	116	1544	206	-818	-109	997	137.5	18.3
11	487	69	100	100	150	150	150	150	200	609	0	0	1609	116	2086	144	-1203	-83	1176	182.6	12.6
12	704	34	100	100	150	150	150	150	200	987	0	0	1987	116	2803	96	-1713	-59	1477	215.1	7.4
TOTAL																3133		-1196			220

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.6)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 1, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	18	32	48	66	86	108	132	158	186	216

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	95	0	0	0	0	0	0	0	0	0	95	32	21	3	32	5	168	6.0	1.0
2	52	245	100	100	116	0	0	0	0	0	0	0	316	46	127	31	46	11	302	0.0	0.0
3	72	439	100	100	150	150	28	0	0	0	0	0	528	60	265	116	24	11	397	11.2	4.9
4	90	581	100	100	150	150	150	2	0	0	0	0	652	74	268	155	90	52	495	26.7	15.5
5	110	593	100	100	150	150	150	150	82	0	0	0	882	74	589	350	-106	-63	594	48.9	29.0
6	130	568	100	100	150	150	150	150	200	114	0	0	1114	88	993	563	-382	-217	705	103.8	58.9
7	150	538	100	100	150	150	150	150	200	214	0	0	1214	102	1182	635	-516	-278	771	149.6	80.4
8	178	482	100	100	150	150	150	150	200	226	0	0	1336	102	1205	580	-472	-227	813	176.7	85.1
9	240	456	100	100	150	150	150	150	200	460	0	0	1460	102	1649	751	-848	-386	884	194.6	88.7
10	332	133	100	100	150	150	150	150	200	649	0	0	1649	116	2007	268	-1103	-147	997	275.0	36.7
11	487	69	100	100	150	150	150	150	200	1000	27	0	2027	116	2793	192	-1681	-116	1176	359.0	24.7
12	704	34	100	100	150	150	150	150	200	1000	512	0	2512	116	4958	171	-3580	-123	1477	436.6	15.0
TOTAL																3817		-1477			440

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.7)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 1, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	19	35	51	67	83	99	115	131	147	163

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	0	0	0	0	156	32	46	8	39	7	168	1.0	0.2
2	52	245	100	100	108	0	0	0	0	0	0	0	308	46	131	32	38	9	302	0.0	0.0
3	72	439	100	100	150	81	0	0	0	0	0	0	431	60	222	97	15	6	397	2.9	1.3
4	90	581	100	100	150	150	31	0	0	0	0	0	531	74	308	179	-17	-10	495	6.1	3.5
5	110	593	100	100	150	150	150	7	0	0	0	0	657	74	435	258	-75	-44	594	10.7	6.3
6	130	568	100	100	150	150	150	133	0	0	0	0	783	88	585	332	-155	-88	705	19.8	11.2
7	150	538	100	100	150	150	150	150	52	0	0	0	852	102	677	364	-209	-113	771	27.4	14.7
8	178	482	100	100	150	150	150	150	102	0	0	0	902	102	746	359	-251	-121	813	30.1	14.5
9	240	456	100	100	150	150	150	150	188	0	0	0	988	102	864	394	-322	-147	884	35.1	16.0
10	332	133	100	100	150	150	150	150	200	117	0	0	1117	116	1065	142	-452	-60	997	50.6	6.7
11	487	69	100	100	150	150	150	150	200	344	0	0	1344	116	1422	98	-685	-47	1176	70.9	4.9
12	704	34	100	100	150	150	150	150	200	654	0	0	1654	116	1909	66	-1002	-34	1477	74.7	2.6
TOTAL																2328		-642			82

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.8)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 1, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	19	35	51	67	83	99	115	131	147	163

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	0	0	0	0	141	32	40	7	37	6	168	2.2	0.4
2	52	245	100	100	118	0	0	0	0	0	0	0	318	46	137	34	37	9	302	0.0	0.0
3	72	439	100	100	150	119	0	0	0	0	0	0	469	60	252	111	5	2	397	6.2	2.7
4	90	581	100	100	150	150	78	0	0	0	0	0	578	74	355	206	-38	-22	495	14.1	8.2
5	110	593	100	100	150	150	150	87	0	0	0	0	737	74	530	314	-126	-75	594	24.3	14.4
6	130	568	100	100	150	150	150	150	97	0	0	0	897	88	739	419	-247	-140	705	48.7	27.7
7	150	538	100	100	150	150	150	150	177	0	0	0	977	102	849	456	-313	-168	771	69.6	37.4
8	178	482	100	100	150	150	150	150	200	49	0	0	1049	102	958	461	-383	-184	813	79.7	38.4
9	240	456	100	100	150	150	150	150	200	148	0	0	1148	102	1113	508	-484	-221	884	89.2	40.6
10	332	133	100	100	150	150	150	150	200	297	0	0	1297	116	1348	180	-636	-85	997	126.5	16.9
11	487	69	100	100	150	150	150	150	200	574	0	0	1574	116	1783	123	-920	-63	1176	167.9	11.5
12	704	34	100	100	150	150	150	150	200	943	0	0	1943	116	2363	81	-1298	-45	1477	196.6	6.8
TOTAL																2899		-985			205

ABBREVIATIONS:
- IG: INCOME GROUP
- IL: INCOME LEVEL (L.E./MONTH)
- MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
- HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
- MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
- EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
- TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
- OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
- ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
- WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
- TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.9)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 1, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILL/KWH)	19	35	51	67	83	99	115	131	147	163

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	0	0	0	0	115	32	29	5	34	6	168	4.4	0.7
2	52	245	100	100	133	0	0	0	0	0	0	0	333	46	146	36	36	9	302	0.1	0.0
3	72	439	100	100	150	150	32	0	0	0	0	0	532	60	277	122	15	6	397	11.6	5.1
4	90	581	100	100	150	150	150	7	0	0	0	0	657	74	286	166	75	43	495	27.5	16.0
5	110	593	100	100	150	150	150	150	70	0	0	0	870	74	552	328	-75	-44	594	46.9	27.8
6	130	568	100	100	150	150	150	150	200	87	0	0	1087	88	868	493	-272	-154	705	97.0	55.0
7	150	538	100	100	150	150	150	150	200	185	0	0	1185	102	1022	549	-372	-200	771	139.8	75.2
8	178	482	100	100	150	150	150	150	200	294	0	0	1294	102	1194	575	-484	-233	813	162.5	78.3
9	240	456	100	100	150	150	150	150	200	415	0	0	1415	102	1384	631	-608	-277	884	179.4	81.8
10	332	133	100	100	150	150	150	150	200	598	0	0	1598	116	1671	223	-795	-106	997	253.5	33.8
11	487	69	100	100	150	150	150	150	200	956	0	0	1956	116	2234	154	-1162	-80	1176	329.0	22.6
12	704	34	100	100	150	150	150	150	200	1000	424	0	2424	116	3799	131	-2470	-85	1477	399.4	13.7
TOTAL																3411		-1116			410

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.10)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 1, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	53	73	95	119	145	173	203	235

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	0	0	0	0	156	35	46	8	39	7	168	0.8	0.1
2	52	245	100	100	110	0	0	0	0	0	0	0	310	53	135	33	35	9	302	0.4	0.1
3	72	439	100	100	150	86	0	0	0	0	0	0	436	73	236	103	4	2	397	6.4	2.8
4	90	581	100	100	150	150	37	0	0	0	0	0	537	95	334	194	-39	-23	495	12.4	7.2
5	110	593	100	100	150	150	150	15	0	0	0	0	665	119	484	287	-119	-71	594	31.2	18.5
6	130	568	100	100	150	150	150	144	0	0	0	0	794	119	668	379	-233	-132	705	39.1	22.2
7	150	534	100	100	150	150	150	150	64	0	0	0	864	145	788	424	-314	-169	771	55.4	29.8
8	178	482	100	100	150	150	150	150	116	0	0	0	916	145	879	423	-376	-181	813	61.4	29.6
9	240	456	100	100	150	150	150	150	200	3	0	0	1003	173	1031	470	-481	-219	884	90.9	41.4
10	332	133	100	100	150	150	150	150	200	134	0	0	1134	173	1303	174	-681	-91	997	104.6	13.9
11	487	69	100	100	150	150	150	150	200	364	0	0	1364	173	1780	122	-1032	-71	1176	143.6	9.9
12	704	34	100	100	150	150	150	150	200	679	0	0	1679	173	2434	84	-1514	-52	1477	154.3	5.3
								TOTAL								2701		-992			181

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.11)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 1, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	53	73	95	119	145	173	203	235

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	0	0	0	0	141	35	40	7	37	6	168	1.7	0.3
2	52	245	100	100	123	0	0	0	0	0	0	0	323	53	143	35	34	8	302	0.9	0.2
3	72	439	100	100	150	130	0	0	0	0	0	0	480	73	274	120	-11	-5	397	13.6	6.0
4	90	581	100	100	150	150	92	0	0	0	0	0	592	95	396	230	-72	-42	495	28.7	16.7
5	110	593	100	100	150	150	150	108	0	0	0	0	758	119	617	366	-201	-119	594	72.1	42.8
6	130	568	100	100	150	150	150	150	125	0	0	0	925	145	894	508	-387	-220	705	131.1	74.4
7	150	534	100	100	150	150	150	150	200	7	0	0	1007	173	1039	559	-487	-262	771	180.3	96.9
8	178	482	100	100	150	150	150	150	200	83	0	0	1083	173	1197	577	-603	-290	813	206.2	99.3
9	240	456	100	100	150	150	150	150	200	158	0	0	1158	173	1353	617	-718	-327	884	209.3	95.4
10	332	133	100	100	150	150	150	150	200	338	0	0	1338	173	1726	230	-993	-132	997	260.5	34.7
11	487	69	100	100	150	150	150	150	200	623	0	0	1623	173	2318	159	-1428	-98	1176	341.4	23.5
12	704	34	100	100	150	150	150	150	200	1000	5	0	2005	203	3113	107	-2013	-69	1477	498.3	17.1
							TOTAL									3514		-1550			507

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.12)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 1, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	53	73	95	119	145	173	203	235

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	0	0	0	0	115	35	29	5	34	6	168	3.4	0.6
2	52	245	100	100	144	0	0	0	0	0	0	0	344	53	156	38	32	8	302	1.8	0.5
3	72	439	100	100	150	54	0	0	0	0	0	0	554	73	208	91	96	42	397	25.7	11.3
4	90	581	100	100	150	150	35	0	0	0	0	0	685	95	332	192	44	26	495	56.2	32.6
5	110	593	100	100	150	150	150	150	112	0	0	0	912	145	872	517	-372	-220	594	189.5	112.4
6	130	568	100	100	150	150	150	150	200	142	0	0	1142	173	1320	749	-693	-394	705	333.8	189.5
7	150	534	100	100	150	150	150	150	200	244	0	0	1244	173	1531	823	-849	-456	771	361.3	194.2
8	178	482	100	100	150	150	150	150	200	361	0	0	1361	173	1774	854	-1028	-495	813	418.6	201.6
9	240	456	100	100	150	150	150	150	200	487	0	0	1487	173	2036	928	-1220	-556	884	460.6	209.9
10	332	133	100	100	150	150	150	150	200	680	0	0	1680	173	2436	325	-1515	-202	997	521.7	69.5
11	487	69	100	100	150	150	150	150	200	1000	56	0	2056	203	3237	223	-2110	-145	1176	830.5	57.1
12	704	34	100	100	150	150	150	150	200	1000	549	0	2549	203	4438	153	-3040	-105	1477	1011.8	34.8
TOTAL																4899		-2492			1114

ABBREVIATIONS:

IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.13)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 1, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	35	50	65	80	95	110	125	140	155

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	0	0	0	0	156	35	48	8	38	6	168	0.8	0.1
2	52	245	100	100	107	0	0	0	0	0	0	0	307	50	130	32	38	9	302	0.1	0.0
3	72	439	100	100	150	80	0	0	0	0	0	0	430	65	218	96	17	8	397	3.8	1.7
4	90	581	100	100	150	150	29	0	0	0	0	0	529	80	301	175	-11	-6	495	7.0	4.1
5	110	593	100	100	150	150	150	4	0	0	0	0	654	95	422	250	-63	-37	594	17.7	10.5
6	130	568	100	100	150	150	150	131	0	0	0	0	781	95	566	321	-138	-78	705	22.5	12.8
7	150	534	100	100	150	150	150	150	49	0	0	0	849	110	653	351	-187	-101	771	30.1	16.2
8	178	482	100	100	150	150	150	150	99	0	0	0	899	110	719	346	-226	-109	813	33.2	16.0
9	240	456	100	100	150	150	150	150	185	0	0	0	985	110	832	379	-292	-133	884	39.0	17.8
10	332	133	100	100	150	150	150	150	200	114	0	0	1114	125	1023	136	-412	-55	997	55.7	7.4
11	487	69	100	100	150	150	150	150	200	340	0	0	1340	125	1362	94	-627	-43	1176	78.0	5.4
12	704	34	100	100	150	150	150	150	200	649	0	0	1649	125	1826	63	-921	-32	1477	81.8	2.8
								TOTAL								2251		-571			95

ABBREVIATIONS:

IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.14)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 1, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	35	50	65	80	95	110	125	140	155

IG	IL	HH No*	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	0	0	0	0	141	35	41	7	36	6	168	1.7	0.3
2	52	245	100	100	115	0	0	0	0	0	0	0	315	50	135	33	38	9	302	0.3	0.1
3	72	439	100	100	150	115	0	0	0	0	0	0	465	65	246	108	9	4	397	7.9	3.5
4	90	581	100	100	150	150	73	0	0	0	0	0	573	80	343	199	-29	-17	495	16.1	9.3
5	110	593	100	100	150	150	150	81	0	0	0	0	731	95	509	302	-108	-64	594	40.5	24.0
6	130	568	100	100	150	150	150	150	90	0	0	0	890	110	707	401	-219	-124	705	71.4	40.5
7	150	534	100	100	150	150	150	150	170	0	0	0	970	110	812	437	-280	-151	771	76.8	41.3
8	178	482	100	100	150	150	150	150	200	42	0	0	1042	125	915	441	-344	-165	813	109.0	52.5
9	240	456	100	100	150	150	150	150	200	140	0	0	1140	125	1062	484	-437	-199	884	121.8	55.5
10	332	133	100	100	150	150	150	150	200	288	0	0	1288	125	1284	171	-578	-77	997	138.5	18.5
11	487	69	100	100	150	150	150	150	200	564	0	0	1564	125	1698	117	-840	-58	1176	184.6	12.7
12	704	34	100	100	150	150	150	150	200	930	0	0	1930	125	2247	77	-1189	-41	1477	215.5	7.4
TOTAL																2777		-877			266

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH No*: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.15)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 1, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	35	50	65	80	95	110	125	140	155

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	0	0	0	0	115	35	30	5	33	5	168	3.4	0.6
2	52	245	100	100	128	0	0	0	0	0	0	0	328	50	143	35	37	9	302	0.7	0.2
3	72	439	100	100	150	150	24	0	0	0	0	0	524	80	296	130	-9	-4	397	26.1	11.5
4	90	581	100	100	150	150	147	0	0	0	0	0	647	80	414	240	-59	-34	495	31.3	18.2
5	110	593	100	100	150	150	150	150	58	0	0	0	858	110	665	394	-194	-115	594	101.9	60.4
6	130	568	100	100	150	150	150	150	200	73	0	0	1073	125	962	546	-373	-212	705	175.1	99.4
7	150	534	100	100	150	150	150	150	200	170	0	0	1170	125	1107	595	-465	-250	771	189.8	102.0
8	178	482	100	100	150	150	150	150	200	280	0	0	1280	125	1272	613	-570	-275	813	222.2	107.0
9	240	456	100	100	150	150	150	150	200	399	0	0	1399	125	1451	661	-683	-311	884	245.0	111.7
10	332	133	100	100	150	150	150	150	200	580	0	0	1580	125	1722	230	-856	-114	997	277.4	37.0
11	487	69	100	100	150	150	150	150	200	937	0	0	1937	125	2258	155	-1195	-82	1176	362.1	24.9
12	704	34	100	100	150	150	150	150	200	1000	399	0	2399	140	3022	104	-1707	-59	1477	521.7	17.9
							TOTAL									3708		-1442			591

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.16)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 1, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	34	50	68	88	110	134	160	188	218

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	55	0	0	0	0	0	0	0	0	155	34	46	8	39	6	168	0.9	0.2
2	52	245	100	100	107	0	0	0	0	0	0	0	307	50	129	32	39	10	302	0.1	0.0
3	72	439	100	100	150	82	0	0	0	0	0	0	432	68	222	97	15	7	397	4.7	2.1
4	90	581	100	100	150	150	32	0	0	0	0	0	532	88	311	181	-19	-11	495	9.4	5.5
5	110	593	100	100	150	150	150	11	0	0	0	0	661	110	450	267	-88	-52	594	25.8	15.3
6	130	568	100	100	150	150	150	140	0	0	0	0	790	110	620	352	-187	-106	705	32.8	18.6
7	150	534	100	100	150	150	150	150	60	0	0	0	860	134	730	392	-258	-139	771	47.2	25.3
8	178	482	100	100	150	150	150	150	112	0	0	0	912	134	814	392	-314	-151	813	52.5	25.3
9	240	456	100	100	150	150	150	150	198	0	0	0	998	134	952	434	-405	-184	884	60.4	27.5
10	332	133	100	100	150	150	150	150	200	128	0	0	1128	160	1201	160	-582	-78	997	89.8	12.0
11	487	69	100	100	150	150	150	150	200	359	0	0	1359	160	1644	113	-899	-62	1176	125.5	8.6
12	704	34	100	100	150	150	150	150	200	673	0	0	1673	160	2247	77	-1330	-46	1477	134.4	4.6
								TOTAL								2505		-806			145

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.17)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 1, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	34	50	68	88	110	134	160	188	218

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	38	0	0	0	0	0	0	0	0	138	34	40	7	36	6	168	2.1	0.4
2	52	245	100	100	115	0	0	0	0	0	0	0	315	50	134	33	39	10	302	0.3	0.1
3	72	439	100	100	150	121	0	0	0	0	0	0	471	68	254	111	5	2	397	9.9	4.3
4	90	581	100	100	150	150	81	0	0	0	0	0	581	88	363	211	-44	-26	495	21.8	12.7
5	110	593	100	100	150	150	150	146	0	0	0	0	746	110	628	373	-219	-130	594	58.6	34.8
6	130	568	100	100	150	150	150	150	114	0	0	0	914	134	817	464	-316	-179	705	110.7	62.8
7	150	534	100	100	150	150	150	150	195	0	0	0	995	134	947	509	-402	-216	771	118.7	63.8
8	178	482	100	100	150	150	150	150	200	72	0	0	1072	160	1093	527	-506	-243	813	177.6	85.5
9	240	456	100	100	150	150	150	150	2000	173	0	0	1173	160	4182	1906	-3538	-1613	884	198.2	90.3
10	332	133	100	100	150	150	150	150	200	325	0	0	1325	160	1579	211	-853	-114	997	224.9	30.0
11	487	69	100	100	150	150	150	150	200	611	0	0	1611	160	2128	146	-1245	-86	1176	298.3	20.5
12	704	34	100	100	150	150	150	150	200	990	0	0	1990	160	2856	98	-1765	-61	1477	351.8	12.1
							TOTAL									4595		-2649			417

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.18)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 1, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	34	50	68	88	110	134	160	188	218

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	9	0	0	0	0	0	0	0	0	109	34	40	7	20	3	168	4.1	0.7
2	52	245	100	100	128	0	0	0	0	0	0	0	328	50	134	33	46	11	302	0.7	0.2
3	72	439	100	100	150	150	36	0	0	0	0	0	536	88	254	111	40	18	397	35.3	15.5
4	90	581	100	100	150	150	150	12	0	0	0	0	662	110	363	211	0	0	495	64.4	37.4
5	110	593	100	100	150	150	150	150	89	0	0	0	889	134	628	373	-141	-84	594	156.3	92.7
6	130	568	100	100	150	150	150	150	200	120	0	0	1120	160	817	464	-203	-115	705	284.6	161.5
7	150	534	100	100	150	150	150	150	200	220	0	0	1220	160	947	509	-278	-149	771	307.9	165.5
8	178	482	100	100	150	150	150	150	200	340	0	0	1340	160	1093	527	-359	-173	813	361.4	174.1
9	240	456	100	100	150	150	150	150	200	464	0	0	1464	160	4182	1906	-3379	-1540	884	397.8	181.3
10	332	133	100	100	150	150	150	150	200	654	0	0	1654	160	1579	211	-672	-90	997	450.6	60.1
11	487	69	100	100	150	150	150	150	200	1000	31	0	2031	188	2128	146	-1015	-70	1176	730.0	50.2
12	704	34	100	100	150	150	150	150	200	1000	517	0	2517	188	2856	98	-1476	-51	1477	888.0	30.5
							TOTAL									4595		-2238			970

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.19)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 1, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	21	35	51	69	89	111	135	161	189	219

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	0	0	0	0	156	35	49	8	37	6	168	0.8	0.1
2	52	245	100	100	108	0	0	0	0	0	0	0	308	51	133	33	36	9	302	0.2	0.0
3	72	439	100	100	150	83	0	0	0	0	0	0	433	69	228	100	10	4	397	5.0	2.2
4	90	581	100	100	150	150	33	0	0	0	0	0	533	89	318	185	-26	-15	495	9.9	5.7
5	110	593	100	100	150	150	150	11	0	0	0	0	661	111	458	272	-96	-57	594	26.3	15.6
6	130	568	100	100	150	150	150	140	0	0	0	0	790	111	630	358	-197	-112	705	33.3	18.9
7	150	534	100	100	150	150	150	150	60	0	0	0	860	135	740	398	-269	-144	771	47.7	25.6
8	178	482	100	100	150	150	150	150	112	0	0	0	912	135	825	397	-324	-156	813	53.0	25.5
9	240	456	100	100	150	150	150	150	199	0	0	0	999	135	966	440	-418	-190	884	61.6	28.1
10	332	133	100	100	150	150	150	150	200	129	0	0	1129	161	1216	162	-597	-80	997	91.3	12.2
11	487	69	100	100	150	150	150	150	200	359	0	0	1359	161	1661	114	-916	-63	1176	126.6	8.7
12	704	34	100	100	150	150	150	150	200	674	0	0	1674	161	2269	78	-1351	-46	1477	136.3	4.7
							TOTAL									2545		-845			147

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.20)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 1, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	21	35	51	69	89	111	135	161	189	219

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	0	0	0	0	141	35	42	7	35	6	168	1.7	0.3
2	52	245	100	100	118	0	0	0	0	0	0	0	318	51	139	34	35	9	302	0.5	0.1
3	72	439	100	100	150	123	0	0	0	0	0	0	473	69	261	114	-1	-1	397	10.6	4.7
4	90	581	100	100	150	150	83	0	0	0	0	0	583	89	372	216	-52	-30	495	22.9	13.3
5	110	593	100	100	150	150	150	148	0	0	0	0	748	111	641	380	-230	-137	594	60.3	35.8
6	130	568	100	100	150	150	150	150	115	0	0	0	915	135	830	471	-328	-186	705	112.5	63.9
7	150	534	100	100	150	150	150	150	196	0	0	0	996	135	961	516	-415	-223	771	120.6	64.8
8	178	482	100	100	150	150	150	150	200	73	0	0	1073	161	1108	534	-520	-250	813	179.9	86.6
9	240	456	100	100	150	150	150	150	200	174	0	0	1174	161	1303	594	-660	-301	884	200.6	91.4
10	332	133	100	100	150	150	150	150	200	327	0	0	1327	161	1599	213	-871	-116	997	228.3	30.4
11	487	69	100	100	150	150	150	150	200	612	0	0	1612	161	2150	148	-1266	-87	1176	301.6	20.8
12	704	34	100	100	150	150	150	150	200	991	0	0	1991	161	2882	99	-1790	-62	1477	355.6	12.2
								TOTAL								3327		-1378			424

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.21)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 1, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	21	35	51	69	89	111	135	161	189	219

IG	IL	HH Nos	CONSUMPTION / HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	0	0	0	0	115	35	42	7	21	3	168	3.4	0.6
2	52	245	100	100	133	0	0	0	0	0	0	0	333	51	139	34	43	11	302	1.0	0.2
3	72	439	100	100	150	150	40	0	0	0	0	0	540	89	261	114	35	15	397	37.2	16.3
4	90	581	100	100	150	150	150	17	0	0	0	0	667	111	372	216	-6	-4	495	67.4	39.1
5	110	593	100	100	150	150	150	150	93	0	0	0	893	135	641	380	-151	-89	594	160.2	95.1
6	130	568	100	100	150	150	150	150	200	122	0	0	1122	161	830	471	-214	-122	705	288.5	163.7
7	150	534	100	100	150	150	150	150	200	223	0	0	1223	161	961	516	-290	-156	771	312.7	168.1
8	178	482	100	100	150	150	150	150	200	342	0	0	1342	161	1108	534	-372	-179	813	366.0	176.2
9	240	456	100	100	150	150	150	150	200	467	0	0	1467	161	1303	594	-499	-227	884	403.3	183.8
10	332	133	100	100	150	150	150	150	200	656	0	0	1656	161	1599	213	-691	-92	997	455.9	60.8
11	487	69	100	100	150	150	150	150	200	1000	33	0	2033	189	2150	148	-1035	-71	1176	736.8	50.7
12	704	34	100	100	150	150	150	150	200	1000	520	0	2520	189	2882	99	-1500	-52	1477	896.8	30.8
								TOTAL								3327		-962			986

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH Nos: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'S)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E.MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS: TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.22)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 1, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	18	32	46	60	74	88	102	116	130	144

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	63	0	0	0	0	0	0	0	0	0	63	18	14	6	21	9	89	4.3	1.8
2	52	577	100	66	0	0	0	0	0	0	0	0	166	32	47	27	44	25	171	0.4	0.2
3	72	846	100	100	51	0	0	0	0	0	0	0	251	46	88	75	49	42	249	0.0	0.0
4	90	966	100	100	114	0	0	0	0	0	0	0	314	46	123	119	49	48	320	0.0	0.0
5	110	851	100	100	150	52	0	0	0	0	0	0	402	60	180	153	40	34	382	1.7	1.5
6	130	653	100	100	150	125	0	0	0	0	0	0	475	60	233	152	28	18	440	3.0	2.0
7	150	412	100	100	150	150	150	47	0	0	0	0	697	88	434	179	-51	-21	624	18.5	7.6
8	178	379	100	100	150	150	150	103	0	0	0	0	753	88	493	187	-80	-30	698	14.0	5.3
9	240	302	100	100	150	150	150	150	41	0	0	0	841	102	593	179	-131	-40	779	20.9	6.3
10	332	55	100	100	150	150	150	150	183	0	0	0	983	102	766	42	-227	-13	884	33.4	1.8
11	487	17	100	100	150	150	150	150	200	218	0	0	1218	116	1091	19	-423	-7	1082	57.4	1.0
12	704	11	100	100	150	150	150	150	200	535	0	0	1535	116	1532	17	-690	-8	1363	72.5	0.8
				TOTAL												1154		58			28

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.23)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 1, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	18	32	46	60	74	88	102	116	130	144

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	22	0	0	0	0	0	0	0	0	0	22	18	5	2	7	3	89	11.1	4.8
2	52	577	100	44	0	0	0	0	0	0	0	0	144	32	38	22	40	23	171	2.2	1.3
3	72	846	100	100	52	0	0	0	0	0	0	0	252	46	89	75	49	42	249	0.0	0.0
4	90	966	100	100	115	0	0	0	0	0	0	0	315	46	123	119	49	48	320	0.0	0.0
5	110	851	100	100	150	80	0	0	0	0	0	0	430	60	200	171	35	30	382	4.1	3.5
6	130	653	100	100	150	150	6	0	0	0	0	0	506	74	256	167	21	14	440	11.2	7.3
7	150	412	100	100	150	150	150	119	0	0	0	0	769	88	510	210	-88	-36	624	36.8	15.2
8	178	379	100	100	150	150	150	150	53	0	0	0	853	102	607	230	-139	-53	698	52.4	19.8
9	240	302	100	100	150	150	150	150	153	0	0	0	953	102	730	220	-207	-63	779	58.8	17.8
10	332	55	100	100	150	150	150	150	200	130	0	0	1130	116	968	53	-348	-19	884	103.8	5.7
11	487	17	100	100	150	150	150	150	200	415	0	0	1415	116	1365	23	-589	-10	1082	140.5	2.4
12	704	11	100	100	150	150	150	150	200	782	0	0	1782	116	1876	21	-898	-10	1363	176.7	1.9
			TOTAL													1314		-31			80

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.24)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	18	32	46	60	74	88	102	116	130	144

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	8	0	0	0	0	0	0	0	0	108	32	25	14	35	20	171	5.2	3.0
3	72	846	100	100	53	0	0	0	0	0	0	0	253	46	89	76	49	42	249	0.0	0.0
4	90	966	100	100	116	0	0	0	0	0	0	0	316	46	124	120	49	48	320	0.0	0.0
5	110	851	100	100	150	125	0	0	0	0	0	0	475	60	233	198	28	24	382	8.0	6.8
6	130	653	100	100	150	150	59	0	0	0	0	0	559	74	303	198	3	2	440	20.2	13.2
7	150	412	100	100	150	150	150	150	88	0	0	0	888	102	650	268	-163	-67	624	89.2	36.7
8	178	379	100	100	150	150	150	150	200	21	0	0	1021	116	816	309	-257	-97	698	136.2	51.6
9	240	302	100	100	150	150	150	150	200	141	0	0	1141	116	983	297	-358	-108	779	152.7	46.1
10	332	55	100	100	150	150	150	150	200	374	0	0	1374	116	1308	72	-554	-30	884	206.7	11.4
11	487	17	100	100	150	150	150	150	200	743	0	0	1743	116	1821	31	-866	-15	1082	278.8	4.7
12	704	11	100	100	150	150	150	150	200	1000	195	0	2195	130	2483	27	-1280	-14	1363	420.8	4.6
			TOTAL													1610		-197			189

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.25)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 1, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	18	32	48	66	86	108	132	158	186	216

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	63	0	0	0	0	0	0	0	0	0	63	18	14	6	21	9	89	4.3	1.8
2	52	577	100	66	0	0	0	0	0	0	0	0	166	32	47	27	44	25	171	0.4	0.2
3	72	846	100	100	53	0	0	0	0	0	0	0	253	48	91	77	48	41	249	0.1	0.0
4	90	966	100	100	117	0	0	0	0	0	0	0	317	48	127	123	46	45	320	-0.0	-0.0
5	110	851	100	100	150	58	0	0	0	0	0	0	408	66	192	164	31	27	382	3.2	2.7
6	130	653	100	100	150	131	0	0	0	0	0	0	481	66	250	163	14	9	440	5.0	3.3
7	150	412	100	100	150	150	150	58	0	0	0	0	708	108	495	204	-107	-44	624	31.4	12.9
8	178	379	100	100	150	150	150	116	0	0	0	0	766	108	570	216	-150	-57	698	25.4	9.6
9	240	302	100	100	150	150	150	150	56	0	0	0	856	132	703	212	-234	-71	779	39.9	12.0
10	332	55	100	100	150	150	150	150	200	1	0	0	1001	158	933	51	-384	-21	884	78.8	4.3
11	487	17	100	100	150	150	150	150	200	241	0	0	1241	158	1388	24	-708	-12	1082	107.1	1.8
12	704	11	100	100	150	150	150	150	200	563	0	0	1563	158	1999	22	-1141	-13	1363	134.8	1.5
			TOTAL													1289		-62			50

ABBREVIATIONS:

IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.26)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 1, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	18	32	48	66	86	108	132	158	186	216

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	22	0	0	0	0	0	0	0	0	0	22	18	5	2	7	3	89	11.1	4.8
2	52	577	100	44	0	0	0	0	0	0	0	0	144	32	38	22	40	23	171	2.2	1.3
3	72	846	100	100	57	0	0	0	0	0	0	0	257	48	93	79	48	41	249	0.1	0.1
4	90	966	100	100	122	0	0	0	0	0	0	0	322	48	130	126	46	45	320	0.0	0.0
5	110	851	100	100	150	93	0	0	0	0	0	0	443	66	220	187	23	19	382	7.4	6.3
6	130	653	100	100	150	150	22	0	0	0	0	0	522	86	288	188	-2	-1	440	19.8	12.9
7	150	412	100	100	150	150	150	145	0	0	0	0	795	108	608	250	-172	-71	624	63.9	26.3
8	178	379	100	100	150	150	150	150	87	0	0	0	887	132	752	285	-266	-101	698	97.9	37.1
9	240	302	100	100	150	150	150	150	191	0	0	0	991	132	917	277	-373	-113	779	109.8	33.2
10	332	55	100	100	150	150	150	150	200	175	0	0	1175	158	1263	69	-619	-34	884	196.1	10.8
11	487	17	100	100	150	150	150	150	200	472	0	0	1472	158	1826	31	-1019	-17	1082	262.8	4.5
12	704	11	100	100	150	150	150	150	200	854	0	0	1854	158	2550	28	-1534	-17	1363	330.8	3.6
				TOTAL												1545		-222			141

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.27)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	18	32	48	66	86	108	132	158	186	216

IG	IL	HH No*	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	8	0	0	0	0	0	0	0	0	108	32	25	14	35	20	171	5.2	3.0
3	72	846	100	100	63	0	0	0	0	0	0	0	263	48	96	81	48	41	249	0.2	0.2
4	90	966	100	100	129	0	0	0	0	0	0	0	329	48	134	130	46	45	320	0.1	0.1
5	110	851	100	100	150	150	2	0	0	0	0	0	502	86	267	227	8	7	382	29.0	24.7
6	130	653	100	100	150	150	89	0	0	0	0	0	589	86	357	233	-34	-22	440	36.0	23.5
7	150	412	100	100	150	150	150	150	142	0	0	0	942	132	839	346	-323	-133	624	164.7	67.8
8	178	379	100	100	150	150	150	150	200	88	0	0	1088	156	1098	416	-501	-190	698	262.8	99.6
9	240	302	100	100	150	150	150	150	200	216	0	0	1216	158	1341	405	-674	-204	779	294.5	88.9
10	332	55	100	100	150	150	150	150	200	464	0	0	1464	158	1811	100	-1008	-55	884	390.8	21.5
11	487	17	100	100	150	150	150	150	200	856	0	0	1856	158	2554	43	-1536	-26	1082	521.5	8.9
12	704	11	100	100	150	150	150	150	200	1000	338	0	2338	186	3582	39	-2299	-25	1363	820.8	9.0
			TOTAL													2035		-544			358

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NO*: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.28)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 1, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	51	67	83	99	115	131	147	163

IG	IL	HH No*	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	65	0	0	0	0	0	0	0	0	0	65	19	15	6	21	9	89	3.8	1.6
2	52	577	100	71	0	0	0	0	0	0	0	0	171	35	53	30	41	24	171	0.0	0.0
3	72	846	100	100	56	0	0	0	0	0	0	0	256	51	99	84	41	35	249	0.2	0.2
4	90	966	100	100	121	0	0	0	0	0	0	0	321	51	139	134	37	36	320	0.0	0.0
5	110	851	100	100	150	58	0	0	0	0	0	0	408	67	203	173	21	17	382	3.3	2.8
6	130	653	100	100	150	132	0	0	0	0	0	0	482	67	263	172	2	1	440	5.4	3.5
7	150	412	100	100	150	150	150	55	0	0	0	0	705	99	492	203	-105	-43	624	25.9	10.7
8	178	379	100	100	150	150	150	111	0	0	0	0	761	99	558	212	-141	-53	698	20.1	7.6
9	240	302	100	100	150	150	150	150	50	0	0	0	850	115	674	203	-208	-63	779	29.5	8.9
10	332	55	100	100	150	150	150	150	192	0	0	0	992	115	870	48	-326	-18	884	44.9	2.5
11	487	17	100	100	150	150	150	150	200	228	0	0	1228	131	1239	21	-566	-10	1082	74.7	1.3
12	704	11	100	100	150	150	150	150	200	547	0	0	1547	131	1741	19	-892	-10	1363	94.2	1.0
			TOTAL													1305		-75			40

ABBREVIATIONS:

IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)

HH NO*: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)

MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)

EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)

TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)

OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)

ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)

WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)

TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]

2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.29)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 1, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	51	67	83	99	115	131	147	163

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	28	0	0	0	0	0	0	0	0	0	28	19	6	3	9	4	89	9.8	4.2
2	52	577	100	55	0	0	0	0	0	0	0	0	155	35	46	26	39	23	171	1.0	0.6
3	72	846	100	100	64	0	0	0	0	0	0	0	264	51	104	88	41	35	249	0.5	0.4
4	90	966	100	100	131	0	0	0	0	0	0	0	331	51	145	140	37	35	320	0.3	0.3
5	110	851	100	100	150	95	0	0	0	0	0	0	445	67	233	198	11	9	382	8.1	6.9
6	130	653	100	100	150	150	24	0	0	0	0	0	524	83	301	197	-14	-9	440	18.8	12.3
7	150	412	100	100	150	150	150	139	0	0	0	0	789	99	592	244	-159	-66	624	52.8	21.7
8	178	379	100	100	150	150	150	150	74	0	0	0	874	115	707	268	-228	-86	698	73.2	27.7
9	240	302	100	100	150	150	150	150	176	0	0	0	976	115	848	256	-312	-94	779	81.9	24.7
10	332	55	100	100	150	150	150	150	200	52	0	0	1152	131	963	53	-331	-18	884	137.2	7.5
11	487	17	100	100	150	150	150	150	200	440	0	0	1440	131	1572	27	-783	-13	1082	183.2	3.1
12	704	11	100	100	150	150	150	150	200	813	0	0	1813	131	2159	24	-1165	-13	1363	230.3	2.5
			TOTAL													1523		-194			112

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.30)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	51	67	83	99	115	131	147	163

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	0	0	0	0	129	35	35	20	36	21	171	2.7	1.6
3	72	846	100	100	77	0	0	0	0	0	0	0	277	51	112	95	40	34	249	0.9	0.8
4	90	966	100	100	147	0	0	0	0	0	0	0	347	51	155	150	36	34	320	0.9	0.8
5	110	851	100	100	150	150	5	0	0	0	0	0	505	83	282	240	-5	-4	382	27.5	23.4
6	130	653	100	100	150	150	94	0	0	0	0	0	594	83	371	242	-45	-29	440	34.5	22.5
7	150	412	100	100	150	150	150	150	130	0	0	0	930	115	784	323	-274	-113	624	127.2	52.4
8	178	379	100	100	150	150	150	150	200	61	0	0	1061	131	977	370	-395	-150	698	185.8	70.4
9	240	302	100	100	150	150	150	150	200	186	0	0	1186	131	1173	354	-523	-158	779	208.3	62.9
10	332	55	100	100	150	150	150	150	200	419	0	0	1419	131	1539	85	-761	-42	884	273.8	15.1
11	487	17	100	100	150	150	150	150	200	792	0	0	1792	131	2126	36	-1143	-19	1082	363.4	6.2
12	704	11	100	100	150	150	150	150	200	1000	257	0	2257	147	2906	32	-1668	-18	1363	543.4	6.0
TOTAL																1947		-445			272

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.31)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 1, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	53	73	95	119	145	173	203	235

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	65	0	0	0	0	0	0	0	0	0	65	19	15	6	21	9	89	3.8	1.6
2	52	577	100	71	0	0	0	0	0	0	0	0	171	35	53	30	41	24	171	0.0	0.0
3	72	846	100	100	58	0	0	0	0	0	0	0	258	53	102	86	40	34	249	0.4	0.3
4	90	966	100	100	123	0	0	0	0	0	0	0	323	53	143	138	34	33	320	0.1	0.1
5	110	851	100	100	150	63	0	0	0	0	0	0	413	73	215	183	11	9	382	5.1	4.3
6	130	653	100	100	150	87	0	0	0	0	0	0	487	73	236	154	31	20	440	7.7	5.0
7	150	412	100	100	150	150	150	64	0	0	0	0	714	119	554	228	-162	-67	624	39.6	16.3
8	178	379	100	100	150	150	150	122	0	0	0	0	772	119	637	241	-213	-81	698	32.5	12.3
9	240	302	100	100	150	150	150	150	62	0	0	0	862	145	785	237	-312	-94	779	49.5	14.9
10	332	55	100	100	150	150	150	150	200	7	0	0	1007	173	1039	57	-487	-27	884	93.9	5.2
11	487	17	100	100	150	150	150	150	200	247	0	0	1247	173	1538	26	-854	-15	1082	126.0	2.1
12	704	11	100	100	150	150	150	150	200	570	0	0	1570	173	2208	24	-1347	-15	1363	158.1	1.7
			TOTAL													1413		-169			64

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.32)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 1, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	53	73	95	119	145	173	203	235

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	28	0	0	0	0	0	0	0	0	0	28	19	6	3	9	4	89	9.8	4.2
2	52	577	100	55	0	0	0	0	0	0	0	0	155	35	46	26	39	23	171	1.0	0.6
3	72	846	100	100	68	0	0	0	0	0	0	0	268	53	108	91	39	33	249	0.8	0.7
4	90	966	100	100	136	0	0	0	0	0	0	0	336	53	151	146	33	32	320	0.7	0.7
5	110	851	100	100	150	105	0	0	0	0	0	0	455	73	252	215	-3	-2	382	12.0	10.2
6	130	653	100	100	150	150	36	0	0	0	0	0	536	95	333	217	-39	-25	440	28.4	18.5
7	150	412	100	100	150	150	150	150	11	0	0	0	811	145	696	287	-251	-103	624	111.4	45.9
8	178	379	100	100	150	150	150	150	101	0	0	0	901	145	853	323	-358	-136	698	120.9	45.8
9	240	302	100	100	150	150	150	150	200	6	0	0	1006	173	1037	313	-486	-147	779	173.4	52.4
10	332	55	100	100	150	150	150	150	200	189	0	0	1189	173	1417	78	-765	-42	884	233.0	12.8
11	487	17	100	100	150	150	150	150	200	485	0	0	1485	173	2032	35	-1217	-21	1082	307.8	5.2
12	704	11	100	100	150	150	150	150	200	871	0	0	1871	173	2833	31	-1807	-20	1363	388.0	4.3
			TOTAL													1765		-405			201

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.33)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	19	35	53	73	95	119	145	173	203	235

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	0	0	0	0	129	35	35	20	36	21	171	2.7	1.6
3	72	846	100	100	85	0	0	0	0	0	0	0	285	53	119	101	37	32	249	1.6	1.3
4	90	966	100	100	150	8	0	0	0	0	0	0	358	73	167	162	29	28	320	6.2	6.0
5	110	851	100	100	150	150	27	0	0	0	0	0	527	95	322	274	-33	-28	382	42.9	36.5
6	130	653	100	100	150	150	69	0	0	0	0	0	619	95	370	242	-31	-20	440	52.9	34.6
7	150	412	100	100	150	150	150	150	173	0	0	0	973	145	978	403	-444	-183	624	207.9	85.7
8	178	379	100	100	150	150	150	150	200	116	0	0	1116	173	1266	480	-654	-248	698	319.3	121.0
9	240	302	100	100	150	150	150	150	200	246	0	0	1246	173	1535	464	-852	-257	779	356.7	107.7
10	332	55	100	100	150	150	150	150	200	491	0	0	1491	173	2044	112	-1226	-67	884	463.6	25.5
11	487	17	100	100	150	150	150	150	200	884	0	0	1884	173	2860	49	-1827	-31	1082	612.6	10.4
12	704	11	100	100	150	150	150	150	200	1000	372	0	2372	203	4007	44	-2706	-30	1363	952.3	10.5
				TOTAL												2350		-784			451

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.34)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 1, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	35	50	65	80	95	110	125	140	155

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	67	0	0	0	0	0	0	0	0	0	67	20	16	7	21	9	89	3.4	1.5
2	52	577	100	71	0	0	0	0	0	0	0	0	171	35	54	31	40	23	171	0.0	0.0
3	72	846	100	100	55	0	0	0	0	0	0	0	255	50	99	84	41	35	249	0.2	0.1
4	90	966	100	100	120	0	0	0	0	0	0	0	320	50	138	133	37	36	320	0.0	0.0
5	110	851	100	100	150	57	0	0	0	0	0	0	407	65	200	171	23	19	382	2.9	2.5
6	130	653	100	100	150	130	0	0	0	0	0	0	480	65	257	168	6	4	440	4.6	3.0
7	150	412	100	100	150	150	150	53	0	0	0	0	703	95	477	197	-92	-38	624	23.4	9.6
8	178	379	100	100	150	150	150	108	0	0	0	0	758	95	540	205	-124	-47	698	17.7	6.7
9	240	302	100	100	150	150	150	150	47	0	0	0	847	110	650	196	-186	-56	779	26.2	7.9
10	332	55	100	100	150	150	150	150	189	0	0	0	989	110	837	46	-295	-16	884	40.5	2.2
11	487	17	100	100	150	150	150	150	200	225	0	0	1225	125	1190	20	-518	-9	1082	68.0	1.2
12	704	11	100	100	150	150	150	150	200	542	0	0	1542	125	1665	18	-819	-9	1363	85.2	0.9
							TOTAL									1276		-49			36

ABBREVIATIONS:

IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.35)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 1, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	35	50	65	80	95	110	125	140	155

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	33	0	0	0	0	0	0	0	0	0	33	20	8	3	10	4	89	8.6	3.7
2	52	577	100	55	0	0	0	0	0	0	0	0	155	35	47	27	38	22	171	1.0	0.6
3	72	846	100	100	62	0	0	0	0	0	0	0	262	50	103	87	40	34	249	0.3	0.3
4	90	966	100	100	128	0	0	0	0	0	0	0	328	50	143	138	37	36	320	0.2	0.2
5	110	851	100	100	150	91	0	0	0	0	0	0	441	65	227	193	15	13	382	6.8	5.8
6	130	653	100	100	150	150	19	0	0	0	0	0	519	80	291	190	-7	-4	440	16.3	10.6
7	150	412	100	100	150	150	150	133	0	0	0	0	783	95	569	234	-139	-57	624	47.0	19.4
8	178	379	100	100	150	150	150	150	67	0	0	0	867	110	676	256	-201	-76	698	65.2	24.7
9	240	302	100	100	150	150	150	150	168	0	0	0	968	110	810	245	-279	-84	779	72.9	22.0
10	332	55	100	100	150	150	150	150	200	144	0	0	1144	125	1068	59	-441	-24	884	123.7	6.8
11	487	17	100	100	150	150	150	150	200	431	0	0	1431	125	1499	25	-714	-12	1082	166.1	2.8
12	704	11	100	100	150	150	150	150	200	802	0	0	1802	125	2055	23	-1067	-12	1363	208.9	2.3
							TOTAL									1481		-161			99

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)   MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.36)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	35	50	65	80	95	110	125	140	155

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	0	0	0	0	129	35	36	21	35	20	171	2.7	1.6
3	72	846	100	100	72	0	0	0	0	0	0	0	272	50	109	92	40	34	249	0.6	0.5
4	90	966	100	100	142	0	0	0	0	0	0	0	342	50	151	146	36	35	320	0.6	0.5
5	110	851	100	100	150	147	0	0	0	0	0	0	497	65	271	230	2	2	382	13.3	11.3
6	130	653	100	100	150	150	85	0	0	0	0	0	585	80	355	232	-34	-22	440	29.8	19.5
7	150	412	100	100	150	150	150	150	117	0	0	0	917	110	742	306	-240	-99	624	113.0	46.6
8	178	379	100	100	150	150	150	150	200	48	0	0	1048	125	924	350	-349	-132	698	166.5	63.1
9	240	302	100	100	150	150	150	150	200	171	0	0	1171	125	1109	335	-466	-141	779	186.5	56.3
10	332	55	100	100	150	150	150	150	200	403	0	0	1403	125	1457	80	-687	-38	884	246.9	13.6
11	487	17	100	100	150	150	150	150	200	774	0	0	1774	125	2013	34	-1040	-18	1082	329.3	5.6
12	704	11	100	100	150	150	150	150	200	1000	234	0	2234	140	2745	30	-1520	-17	1363	492.8	5.4
						TOTAL										1857		-376			234

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.37)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	34	50	68	88	110	134	160	188	218

IG	IL	HH No*	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	67	0	0	0	0	0	0	0	0	0	67	20	16	7	21	9	89	3.4	1.5
2	52	577	100	69	0	0	0	0	0	0	0	0	169	34	52	30	41	23	171	0.1	0.1
3	72	846	100	100	55	0	0	0	0	0	0	0	255	50	98	83	42	36	249	0.2	0.1
4	90	966	100	100	120	0	0	0	0	0	0	0	320	50	137	132	39	37	320	0.0	0.0
5	110	851	100	100	150	59	0	0	0	0	0	0	409	68	203	173	21	18	382	3.6	3.1
6	130	653	100	100	150	133	0	0	0	0	0	0	483	68	263	172	2	1	440	5.8	3.8
7	150	412	100	100	150	150	150	59	0	0	0	0	709	110	513	212	-125	-51	624	32.8	13.5
8	178	379	100	100	150	150	150	117	0	0	0	0	767	110	590	224	-169	-64	698	26.6	10.1
9	240	302	100	100	150	150	150	150	57	0	0	0	857	134	725	219	-255	-77	779	41.3	12.5
10	332	55	100	100	150	150	150	150	200	2	0	0	1002	160	959	53	-410	-23	884	80.9	4.5
11	487	17	100	100	150	150	150	150	200	242	0	0	1242	160	1420	24	-739	-13	1082	109.7	1.9
12	704	11	100	100	150	150	150	150	200	564	0	0	1564	160	2038	22	-1180	-13	1363	137.8	1.5
							TOTAL									1350		-116			52

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.38)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 1, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	34	50	68	88	110	134	160	188	218

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	33	0	0	0	0	0	0	0	0	0	33	20	8	3	10	4	89	8.6	3.7
2	52	577	100	52	0	0	0	0	0	0	0	0	152	34	45	26	38	22	171	1.3	0.8
3	72	846	100	100	62	0	0	0	0	0	0	0	262	50	102	86	42	35	249	0.3	0.3
4	90	966	100	100	128	0	0	0	0	0	0	0	328	50	142	137	38	37	320	0.2	0.2
5	110	851	100	100	150	97	0	0	0	0	0	0	447	68	234	199	11	10	382	8.7	7.4
6	130	653	100	100	150	150	26	0	0	0	0	0	526	88	305	199	-16	-11	440	21.8	14.3
7	150	412	100	100	150	150	150	149	0	0	0	0	799	110	632	260	-194	-80	624	67.5	27.8
8	178	379	100	100	150	150	150	150	90	0	0	0	890	134	778	295	-290	-110	698	101.7	38.6
9	240	302	100	100	150	150	150	150	194	0	0	0	994	134	946	286	-400	-121	779	113.9	34.4
10	332	55	100	100	150	150	150	150	200	177	0	0	1177	160	1295	71	-650	-36	884	200.9	11.1
11	487	17	100	100	150	150	150	150	200	474	0	0	1474	160	1865	32	-1057	-18	1082	268.8	4.6
12	704	11	100	100	150	150	150	150	200	856	0	0	1856	160	2599	29	-1581	-17	1363	338.1	3.7
							TOTAL									1623		-284			147

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.39)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	20	34	50	68	88	110	134	160	188	218

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	22	0	0	0	0	0	0	0	0	122	34	33	19	34	20	171	3.4	2.0
3	72	846	100	100	72	0	0	0	0	0	0	0	272	50	108	91	41	35	249	0.6	0.5
4	90	966	100	100	142	0	0	0	0	0	0	0	342	50	150	145	38	36	320	0.6	0.5
5	110	851	100	100	150	150	9	0	0	0	0	0	509	88	287	244	-8	-6	382	32.2	27.4
6	130	653	100	100	150	150	98	0	0	0	0	0	598	88	381	249	-53	-34	440	40.1	26.2
7	150	412	100	100	150	150	150	150	149	0	0	0	949	134	873	360	-353	-145	624	172.2	70.9
8	178	379	100	100	150	150	150	150	200	94	0	0	1094	160	1136	430	-536	-203	698	271.6	102.9
9	240	302	100	100	150	150	150	150	200	222	0	0	1222	160	1381	417	-711	-215	779	303.8	91.8
10	332	55	100	100	150	150	150	150	200	468	0	0	1468	160	1854	102	-1049	-58	884	400.5	22.0
11	487	17	100	100	150	150	150	150	200	860	0	0	1860	160	2606	44	-1586	-27	1082	533.6	9.1
12	704	11	100	100	150	150	150	150	200	1000	343	0	2343	188	3649	40	-2364	-26	1363	836.7	9.2
							TOTAL									2142		-624			373

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.40)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 1, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	21	35	51	69	89	111	135	161	189	219

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	69	0	0	0	0	0	0	0	0	0	69	21	17	7	20	9	89	3.0	1.3
2	52	577	100	71	0	0	0	0	0	0	0	0	171	35	55	32	39	22	171	0.0	0.0
3	72	846	100	100	56	0	0	0	0	0	0	0	256	51	101	86	39	33	249	0.2	0.2
4	90	966	100	100	121	0	0	0	0	0	0	0	321	51	141	136	35	34	320	0.0	0.0
5	110	851	100	100	150	60	0	0	0	0	0	0	410	69	209	178	16	14	382	3.9	3.3
6	130	653	100	100	150	134	0	0	0	0	0	0	484	69	270	176	-5	-3	440	6.2	4.0
7	150	412	100	100	150	150	150	60	0	0	0	0	710	111	523	216	-134	-55	624	33.7	13.9
8	178	379	100	100	150	150	150	118	0	0	0	0	768	111	601	228	-179	-68	698	27.4	10.4
9	240	302	100	100	150	150	150	150	58	0	0	0	858	135	737	223	-267	-81	779	42.3	12.8
10	332	55	100	100	150	150	150	150	200	3	0	0	1003	161	973	54	-423	-23	884	82.3	4.5
11	487	17	100	100	150	150	150	150	200	242	0	0	1242	161	1435	24	-754	-13	1082	110.7	1.9
12	704	11	100	100	150	150	150	150	200	565	0	0	1565	161	2059	23	-1201	-13	1363	139.7	1.5
						TOTAL										1382		-145			54

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.41)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 1, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	21	35	51	69	89	111	135	161	189	219

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	38	0	0	0	0	0	0	0	0	0	38	21	10	4	11	5	89	7.6	3.2
2	52	577	100	55	0	0	0	0	0	0	0	0	155	35	48	28	37	21	171	1.0	0.6
3	72	846	100	100	64	0	0	0	0	0	0	0	264	51	106	90	38	32	249	0.5	0.4
4	90	966	100	100	131	0	0	0	0	0	0	0	331	51	147	142	34	33	320	0.3	0.3
5	110	851	100	100	150	99	0	0	0	0	0	0	449	69	241	205	5	4	382	9.4	8.0
6	130	653	100	100	150	150	28	0	0	0	0	0	528	89	313	204	-24	-15	440	22.9	14.9
7	150	412	100	100	150	150	150	150	1	0	0	0	801	135	645	266	-206	-85	624	94.8	39.1
8	178	379	100	100	150	150	150	150	91	0	0	0	891	135	791	300	-302	-114	698	103.4	39.2
9	240	302	100	100	150	150	150	150	195	0	0	0	995	135	959	290	-413	-125	779	115.7	35.0
10	332	55	100	100	150	150	150	150	200	178	0	0	1178	161	1311	72	-665	-37	884	203.4	11.2
11	487	17	100	100	150	150	150	150	200	475	0	0	1475	161	1885	32	-1076	-18	1082	271.9	4.6
12	704	11	100	100	150	150	150	150	200	878	0	0	1878	161	2663	29	-1634	-18	1363	356.3	3.9
						TOTAL										1662		-316			160

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.42)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 1, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6	7	8	9	10
UPPER LIMIT (KWH)	100	200	350	500	650	800	1000	2000	4000	4000+
TARIFF (MILLS/KWH)	21	35	51	69	89	111	135	161	189	219

IG	IL	HH Nos	CONSUMPTION PER HOUSEHOLD IN EACH BAND (KWH)										MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	0	0	0	0	129	35	37	22	33	19	171	2.7	1.6
3	72	846	100	100	77	0	0	0	0	0	0	0	277	51	114	97	38	32	249	0.9	0.8
4	90	966	100	100	147	0	0	0	0	0	0	0	347	51	157	152	33	32	320	0.9	0.8
5	110	851	100	100	150	150	13	0	0	0	0	0	513	89	297	253	-16	-13	382	34.0	29.0
6	130	653	100	100	150	150	103	0	0	0	0	0	603	89	393	257	-63	-41	440	42.3	27.7
7	150	412	100	100	150	150	150	150	153	0	0	0	953	135	891	367	-368	-152	624	176.3	72.6
8	178	379	100	100	150	150	150	150	200	96	0	0	1096	161	1153	437	-552	-209	698	275.3	104.4
9	240	302	100	100	150	150	150	150	200	225	0	0	1225	161	1402	423	-730	-220	779	308.5	93.2
10	332	55	100	100	150	150	150	150	200	471	0	0	1471	161	1877	103	-1070	-59	884	406.1	22.3
11	487	17	100	100	150	150	150	150	200	862	0	0	1862	161	2633	45	-1611	-27	1082	539.6	9.2
12	704	11	100	100	150	150	150	150	200	1000	346	0	2346	189	3684	41	-2397	-26	1363	845.2	9.3
							TOTAL									2196		-665			381

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH) MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOTAL EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.43)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 2, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	53	88	116	137

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	52	0	0	0	0	152	32	42	7	42	7	168	1.3	0.2
2	52	245	100	100	110	0	0	0	310	53	130	32	40	10	302	0.4	0.1
3	72	439	100	100	217	0	0	0	417	53	198	87	31	13	397	0.9	0.4
4	90	581	100	100	300	13	0	0	513	88	265	154	17	10	495	4.6	2.7
5	110	593	100	100	300	161	0	0	661	88	421	250	-58	-35	594	17.0	10.1
6	130	568	100	100	300	275	0	0	775	88	541	307	-116	-66	705	17.8	10.1
7	150	538	100	100	300	344	0	0	844	88	614	330	-151	-81	771	18.5	10.0
8	178	482	100	100	300	383	0	0	883	88	655	316	-171	-82	813	17.8	8.6
9	240	456	100	100	300	467	0	0	967	88	744	339	-214	-97	884	21.1	9.6
10	332	133	100	100	300	500	93	0	1093	116	908	121	-309	-41	997	40.5	5.4
11	487	69	100	100	300	500	333	0	1333	116	1242	85	-511	-35	1176	66.2	4.6
12	704	34	100	100	300	500	641	0	1641	116	1671	57	-771	-27	1477	69.2	2.4
		TOTAL										2084		-424			64

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.44)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 2, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	53	88	116	137

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	31	0	0	0	0	131	32	34	6	38	6	168	3.0	0.5
2	52	245	100	100	123	0	0	0	323	53	138	34	39	10	302	0.9	0.2
3	72	439	100	100	233	0	0	0	433	53	208	91	29	13	397	1.6	0.7
4	90	581	100	100	300	34	0	0	534	88	287	166	6	4	495	9.9	5.7
5	110	593	100	100	300	246	0	0	746	88	511	303	-101	-60	594	38.6	22.9
6	130	568	100	100	300	377	0	0	877	88	649	368	-168	-95	705	43.7	24.8
7	150	538	100	100	300	455	0	0	955	88	731	393	-208	-112	771	46.7	25.1
8	178	482	100	100	300	500	0	0	1000	88	779	375	-230	-111	813	47.5	22.9
9	240	456	100	100	300	500	94	0	1094	116	910	415	-310	-141	884	88.6	40.4
10	332	133	100	100	300	500	237	0	1237	116	1109	148	-430	-57	997	101.2	13.5
11	487	69	100	100	300	500	547	0	1547	116	1540	106	-692	-48	1176	156.5	10.8
12	704	34	100	100	300	500	910	0	1910	116	2046	70	-998	-34	1477	182.6	6.3
		TOTAL										2475		-626			174

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.45)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 2, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	53	88	116	137

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	95	0	0	0	0	0	95	18	21	3	32	5	168	12.1	2.0
2	52	245	100	100	144	0	0	0	344	53	152	37	37	9	302	1.8	0.5
3	72	439	100	100	261	0	0	0	461	53	226	99	27	12	397	2.8	1.2
4	90	581	100	100	300	68	0	0	568	88	323	187	-11	-6	495	18.5	10.8
5	110	593	100	100	300	384	0	0	884	88	656	389	-172	-102	594	73.6	43.7
6	130	568	100	100	300	500	46	0	1046	116	843	478	-269	-153	705	143.8	81.6
7	150	538	100	100	300	500	140	0	1140	116	974	523	-349	-187	771	155.6	83.7
8	178	482	100	100	300	500	195	0	1195	116	1050	506	-395	-190	813	161.1	77.6
9	240	456	100	100	300	500	307	0	1307	116	1206	550	-489	-223	884	178.4	81.3
10	332	133	100	100	300	500	476	0	1476	116	1441	192	-632	-84	997	202.0	26.9
11	487	69	100	100	300	500	903	0	1903	116	2036	140	-992	-68	1176	306.6	21.1
12	704	34	100	100	300	500	1000	357	2357	137	2758	95	-1465	-50	1477	482.1	16.6
		TOTAL										3200		-1038			447

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.46)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 2, -0.2 PRICE ELASTICITY, URBAN EGYPT

	BAND	1	2	3	4	5	6
UPPER LIMIT	(KWH)	100	200	500	1000	2000	2000+
TARIFF	(MILLS/KWH)	18	32	57	108	158	201

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	52	0	0	0	0	152	32	42	7	42	7	168	1.3	0.2
2	52	245	100	100	114	0	0	0	314	57	138	34	32	8	302	0.8	0.2
3	72	439	100	100	222	0	0	0	422	57	212	93	17	7	397	1.7	0.7
4	90	581	100	100	300	19	0	0	519	108	290	168	-8	-5	495	9.0	5.2
5	110	593	100	100	300	172	0	0	672	108	488	290	-126	-75	594	29.2	17.3
6	130	568	100	100	300	289	0	0	789	108	640	363	-215	-122	705	31.4	17.8
7	150	538	100	100	300	358	0	0	858	108	729	392	-266	-143	771	32.5	17.5
8	178	482	100	100	300	398	0	0	898	108	781	376	-297	-143	813	31.8	15.3
9	240	456	100	100	300	484	0	0	984	108	892	407	-362	-165	884	37.4	17.0
10	332	133	100	100	300	500	112	0	1112	158	1126	150	-526	-70	997	77.5	10.3
11	487	69	100	100	300	500	358	0	1358	158	1592	110	-861	-59	1176	122.6	8.4
12	704	34	100	100	300	500	672	0	1672	158	2187	75	-1287	-44	1477	131.4	4.5
		TOTAL										2464		-804			115

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.47)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 2, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	57	108	158	201

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	31	0	0	0	0	131	32	34	6	38	6	168	3.0	0.5
2	52	245	100	100	132	0	0	0	332	57	150	37	32	8	302	2.0	0.5
3	72	439	100	100	245	0	0	0	445	57	228	100	16	7	397	3.3	1.4
4	90	581	100	100	300	49	0	0	549	108	329	191	-28	-16	495	20.2	11.7
5	110	593	100	100	300	275	0	0	775	108	622	369	-197	-117	594	67.7	40.1
6	130	568	100	100	300	411	0	0	911	108	798	453	-298	-169	705	77.0	43.7
7	150	538	100	100	300	492	0	0	992	108	903	485	-359	-193	771	82.6	44.4
8	178	482	100	100	300	500	39	0	1039	158	987	475	-417	-201	813	152.3	73.3
9	240	456	100	100	300	500	137	0	1137	158	1173	535	-549	-250	884	170.5	77.7
10	332	133	100	100	300	500	285	0	1285	158	1454	194	-749	-100	997	194.1	25.9
11	487	69	100	100	300	500	609	0	1609	158	2068	142	-1185	-82	1176	291.8	20.1
12	704	34	100	100	300	500	987	0	1987	158	2785	96	-1695	-58	1477	343.6	11.8
			TOTAL									3081		-1165			351

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.48)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 2, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	57	108	158	201

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	95	0	0	0	0	0	95	18	21	3	32	5	168	12.1	2.0
2	52	245	100	100	162	0	0	0	362	57	171	42	28	7	302	4.1	1.0
3	72	439	100	100	285	0	0	0	485	57	255	112	11	5	397	6.0	2.6
4	90	581	100	100	300	98	0	0	598	108	392	228	-64	-37	495	38.5	22.4
5	110	593	100	100	300	446	0	0	946	108	843	500	-324	-193	594	131.6	78.1
6	130	568	100	100	300	500	114	0	1114	158	1129	641	-518	-294	705	275.6	156.4
7	150	538	100	100	300	500	214	0	1214	158	1319	709	-653	-351	771	298.5	160.4
8	178	482	100	100	300	500	273	0	1273	158	1431	689	-733	-353	813	309.9	149.3
9	240	456	100	100	300	500	392	0	1392	158	1656	755	-893	-407	884	342.3	156.0
10	332	133	100	100	300	500	572	0	1572	158	1998	266	-1136	-151	997	387.4	51.6
11	487	69	100	100	300	500	1000	27	2027	201	2874	198	-1763	-121	1176	793.0	54.6
12	704	34	100	100	300	500	1000	512	2512	201	4044	139	-2667	-92	1477	964.4	33.2
.		TOTAL										4282		-1983			868

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.49)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 2, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	59	99	131	155

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	156	35	46	8	39	7	168	0.8	0.1
2	52	245	100	100	116	0	0	0	316	59	147	36	26	6	302	1.1	0.3
3	72	439	100	100	224	0	0	0	424	59	223	98	9	4	397	2.2	0.9
4	90	581	100	100	300	22	0	0	522	99	303	176	-17	-10	495	8.6	5.0
5	110	593	100	100	300	168	0	0	668	99	477	283	-110	-66	594	23.7	14.0
6	130	568	100	100	300	283	0	0	783	99	613	348	-184	-104	705	24.9	14.2
7	150	538	100	100	300	352	0	0	852	99	695	374	-228	-123	771	25.9	13.9
8	178	482	100	100	300	392	0	0	892	99	743	358	-254	-122	813	25.3	12.2
9	240	456	100	100	300	477	0	0	977	99	844	385	-308	-140	884	29.7	13.6
10	332	133	100	100	300	500	104	0	1104	131	1035	138	-429	-57	997	54.8	7.3
11	487	69	100	100	300	500	344	0	1344	131	1412	97	-675	-46	1176	86.0	5.9
12	704	34	100	100	300	500	654	0	1654	131	1899	65	-992	-34	1477	90.6	3.1
		TOTAL										2365		-686			91

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.50)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 2, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	59	99	131	155

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	141	35	40	7	37	6	168	1.7	0.3
2	52	245	100	100	136	0	0	0	336	59	161	39	23	6	302	2.7	0.7
3	72	439	100	100	251	0	0	0	451	59	243	106	5	2	397	4.3	1.9
4	90	581	100	100	300	55	0	0	555	99	343	199	-38	-22	495	19.2	11.1
5	110	593	100	100	300	263	0	0	763	99	590	350	-171	-102	594	54.0	32.1
6	130	568	100	100	300	397	0	0	897	99	749	425	-257	-146	705	61.4	34.9
7	150	538	100	100	300	477	0	0	977	99	844	454	-308	-166	771	65.9	35.4
8	178	482	100	100	300	500	23	0	1023	131	907	437	-346	-167	813	107.5	51.8
9	240	456	100	100	300	500	120	0	1120	131	1060	483	-446	-203	884	120.8	55.1
10	332	133	100	100	300	500	265	0	1265	131	1288	172	-594	-79	997	137.2	18.3
11	487	69	100	100	300	500	574	0	1574	131	1774	122	-910	-63	1176	203.7	14.0
12	704	34	100	100	300	500	943	0	1943	131	2354	81	-1288	-44	1477	238.5	8.2
		TOTAL										2874		-977			264

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.51)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 2, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	59	99	131	155

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	115	35	29	5	34	6	168	3.4	0.6
2	52	245	100	100	170	0	0	0	370	59	185	45	18	4	302	5.4	1.3
3	72	439	100	100	295	0	0	0	495	59	274	120	-2	-1	397	7.8	3.4
4	90	581	100	100	300	111	0	0	611	99	409	237	-74	-43	495	37.1	21.5
5	110	593	100	100	300	423	0	0	923	99	780	463	-274	-162	594	105.2	62.4
6	130	568	100	100	300	500	87	0	1087	131	1008	572	-412	-234	705	195.5	111.0
7	150	538	100	100	300	500	185	0	1185	131	1162	625	-512	-275	771	211.9	113.9
8	178	482	100	100	300	500	242	0	1242	131	1252	603	-571	-275	813	219.6	105.7
9	240	456	100	100	300	500	358	0	1358	131	1434	654	-689	-314	884	242.6	110.6
10	332	133	100	100	300	500	534	0	1534	131	1711	228	-869	-116	997	274.8	36.6
11	487	69	100	100	300	500	956	0	1956	131	2374	163	-1301	-90	1176	399.2	27.5
12	704	34	100	100	300	500	1000	424	2424	155	3232	111	-1903	-65	1477	621.0	21.4
		TOTAL										3826		-1565			616

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.52)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 2, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	63	119	173	219

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	156	35	46	8	39	7	168	0.8	0.1
2	52	245	100	100	119	0	0	0	319	63	155	38	20	5	302	1.8	0.4
3	72	439	100	100	228	0	0	0	428	63	237	104	-2	-1	397	3.2	1.4
4	90	581	100	100	300	27	0	0	527	119	330	192	-41	-24	495	14.1	8.2
5	110	593	100	100	300	177	0	0	677	119	544	323	-173	-103	594	36.5	21.7
6	130	568	100	100	300	294	0	0	794	119	711	404	-276	-157	705	39.1	22.2
7	150	538	100	100	300	364	0	0	864	119	811	436	-338	-181	771	40.9	22.0
8	178	482	100	100	300	405	0	0	905	119	870	419	-374	-180	813	40.5	19.5
9	240	456	100	100	300	491	0	0	991	119	993	452	-449	-205	884	47.1	21.4
10	332	133	100	100	300	500	120	0	1120	173	1255	167	-641	-85	997	93.9	12.5
11	487	69	100	100	300	500	364	0	1364	173	1761	121	-1013	-70	1176	143.6	9.9
12	704	34	100	100	300	500	679	0	1679	173	2415	83	-1494	-51	1477	154.3	5.3
		TOTAL										2747		-1045			145

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.53)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 2, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	63	119	173	219

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	141	35	40	7	37	6	168	1.7	0.3
2	52	245	100	100	143	0	0	0	343	63	173	42	15	4	302	4.3	1.0
3	72	439	100	100	260	0	0	0	460	63	261	115	-9	-4	397	6.5	2.9
4	90	581	100	100	300	68	0	0	568	119	389	226	-77	-45	495	32.1	18.6
5	110	593	100	100	300	286	0	0	786	119	700	415	-269	-160	594	84.4	50.1
6	130	568	100	100	300	425	0	0	925	119	899	510	-391	-222	705	96.8	54.9
7	150	538	100	100	300	500	7	0	1007	173	1020	548	-468	-251	771	180.3	96.9
8	178	482	100	100	300	500	55	0	1055	173	1120	539	-541	-261	813	184.8	89.0
9	240	456	100	100	300	500	154	0	1154	173	1325	604	-692	-316	884	206.2	94.0
10	332	133	100	100	300	500	304	0	1304	173	1637	218	-922	-123	997	234.5	31.3
11	487	69	100	100	300	500	623	0	1623	173	2299	158	-1409	-97	1176	341.4	23.5
12	704	34	100	100	300	500	1000	5	2005	219	3095	106	-1995	-69	1477	549.0	18.9
		TOTAL										3489		-1537			481

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.54)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 2, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	63	119	173	219

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	115	35	29	5	34	6	168	3.4	0.6
2	52	245	100	100	185	0	0	0	385	63	205	50	6	2	302	8.6	2.1
3	72	439	100	100	300	15	0	0	515	119	313	137	-31	-13	397	51.9	22.8
4	90	581	100	100	300	135	0	0	635	119	484	281	-136	-79	495	61.6	35.7
5	110	593	100	100	300	469	0	0	969	119	961	570	-430	-255	594	164.9	97.9
6	130	568	100	100	300	500	142	0	1142	173	1300	738	-674	-383	705	333.8	189.5
7	150	538	100	100	300	500	244	0	1244	173	1512	813	-830	-446	771	361.3	194.2
8	178	482	100	100	300	500	305	0	1305	173	1639	789	-923	-445	813	375.8	181.0
9	240	456	100	100	300	500	426	0	1426	173	1890	861	-1108	-505	884	414.0	188.7
10	332	133	100	100	300	500	611	0	1611	173	2274	303	-1391	-185	997	469.0	62.5
11	487	69	100	100	300	500	1000	56	2056	219	3229	222	-2101	-145	1176	915.0	63.0
12	704	34	100	100	300	500	1000	549	2549	219	4524	156	-3127	-108	1477	1114.7	38.3
		TOTAL										4926		-2556			1076

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.55)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 2, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	35	60	95	125	147

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	156	35	48	8	38	6	168	0.8	0.1
2	52	245	100	100	116	0	0	0	316	60	150	37	24	6	302	1.2	0.3
3	72	439	100	100	225	0	0	0	425	60	228	100	5	2	397	2.4	1.1
4	90	581	100	100	300	23	0	0	523	95	308	179	-21	-12	495	8.3	4.8
5	110	593	100	100	300	165	0	0	665	95	470	279	-105	-63	594	21.0	12.5
6	130	568	100	100	300	281	0	0	781	95	602	342	-174	-99	705	22.5	12.8
7	150	538	100	100	300	349	0	0	849	95	680	365	-214	-115	771	23.1	12.4
8	178	482	100	100	300	389	0	0	889	95	725	349	-238	-115	813	22.5	10.8
9	240	456	100	100	300	474	0	0	974	95	822	375	-288	-131	884	26.6	12.1
10	332	133	100	100	300	500	100	0	1100	125	1002	134	-399	-53	997	49.0	6.5
11	487	69	100	100	300	500	340	0	1340	125	1362	94	-627	-43	1176	78.0	5.4
12	704	34	100	100	300	500	649	0	1649	125	1826	63	-921	-32	1477	81.8	2.8
		TOTAL										2324		-648			82

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.56)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 2, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	35	60	95	125	147

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	141	35	41	7	36	6	168	1.7	0.3
2	52	245	100	100	138	0	0	0	338	60	165	41	20	5	302	3.1	0.8
3	72	439	100	100	253	0	0	0	453	60	248	109	0	0	397	4.8	2.1
4	90	581	100	100	300	59	0	0	559	95	349	203	-43	-25	495	18.9	11.0
5	110	593	100	100	300	258	0	0	758	95	576	342	-160	-95	594	48.5	28.8
6	130	568	100	100	300	390	0	0	890	95	727	412	-239	-135	705	54.7	31.1
7	150	538	100	100	300	470	0	0	970	95	818	440	-286	-154	771	58.9	31.6
8	178	482	100	100	300	500	15	0	1015	125	875	421	-318	-153	813	96.1	46.3
9	240	456	100	100	300	500	111	0	1111	125	1019	464	-409	-187	884	108.0	49.2
10	332	133	100	100	300	500	256	0	1256	125	1236	165	-547	-73	997	123.2	16.4
11	487	69	100	100	300	500	564	0	1564	125	1698	117	-840	-58	1176	184.6	12.7
12	704	34	100	100	300	500	930	0	1930	125	2247	77	-1189	-41	1477	215.5	7.4
		TOTAL										2797		-909			238

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.57)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 2, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	35	60	95	125	147

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	115	35	30	5	33	5	168	3.4	0.6
2	52	245	100	100	174	0	0	0	374	60	191	47	14	3	302	6.2	1.5
3	72	439	100	100	300	1	0	0	501	95	283	124	-8	-4	397	30.8	13.5
4	90	581	100	100	300	118	0	0	618	95	417	242	-78	-45	495	36.4	21.1
5	110	593	100	100	300	412	0	0	912	95	752	446	-252	-149	594	94.1	55.8
6	130	568	100	100	300	500	73	0	1073	125	962	546	-373	-212	705	175.1	99.4
7	150	538	100	100	300	500	170	0	1170	125	1107	595	-465	-250	771	189.8	102.0
8	178	482	100	100	300	500	226	0	1226	125	1191	574	-519	-250	813	196.5	94.6
9	240	456	100	100	300	500	341	0	1341	125	1364	621	-628	-286	884	217.4	99.1
10	332	133	100	100	300	500	514	0	1514	125	1623	216	-793	-106	997	246.0	32.8
11	487	69	100	100	300	500	937	0	1937	125	2258	155	-1195	-82	1176	362.1	24.9
12	704	34	100	100	300	500	1000	399	2399	147	3056	105	-1740	-60	1477	560.4	19.3
			TOTAL									3676		-1435			565

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.58)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 2, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	34	59	110	160	203

IG	IL	HH No*	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	55	0	0	0	0	155	34	46	8	39	6	168	0.9	0.2
2	52	245	100	100	116	0	0	0	316	59	147	36	26	6	302	1.1	0.3
3	72	439	100	100	224	0	0	0	424	59	223	98	9	4	397	2.2	0.9
4	90	581	100	100	300	22	0	0	522	110	306	178	-20	-12	495	10.4	6.0
5	110	593	100	100	300	173	0	0	673	110	506	300	-136	-81	594	30.5	18.1
6	130	568	100	100	300	290	0	0	790	110	660	375	-227	-129	705	32.8	18.6
7	150	538	100	100	300	360	0	0	860	110	752	404	-281	-151	771	34.3	18.5
8	178	482	100	100	300	399	0	0	899	110	804	387	-311	-150	813	33.2	16.0
9	240	456	100	100	300	485	0	0	985	110	917	418	-377	-172	884	39.0	17.8
10	332	133	100	100	300	500	114	0	1114	160	1156	154	-545	-73	997	80.2	10.7
11	487	69	100	100	300	500	359	0	1359	160	1626	112	-881	-61	1176	125.5	8.6
12	704	34	100	100	300	500	673	0	1673	160	2229	77	-1312	-45	1477	134.4	4.6
.		TOTAL										2546		-855			120

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NO*: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000'*)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.59)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 2, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	34	59	110	160	203

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	38	0	0	0	0	138	34	40	7	36	6	168	2.1	0.4
2	52	245	100	100	136	0	0	0	336	59	161	39	23	6	302	2.7	0.7
3	72	439	100	100	251	0	0	0	451	59	243	106	5	2	397	4.3	1.9
4	90	581	100	100	300	55	0	0	555	110	350	203	-45	-26	495	23.1	13.4
5	110	593	100	100	300	277	0	0	777	110	643	381	-217	-129	594	70.6	41.9
6	130	568	100	100	300	414	0	0	914	110	824	468	-322	-183	705	80.6	45.8
7	150	538	100	100	300	495	0	0	995	110	931	500	-385	-207	771	86.4	46.5
8	178	482	100	100	300	500	42	0	1042	160	1018	490	-446	-215	813	157.0	75.6
9	240	456	100	100	300	500	140	0	1140	160	1206	550	-581	-265	884	175.6	80.0
10	332	133	100	100	300	500	288	0	1288	160	1490	199	-784	-104	997	199.6	26.6
11	487	69	100	100	300	500	611	0	1611	160	2110	145	-1227	-84	1176	298.3	20.5
12	704	34	100	100	300	500	990	0	1990	160	2838	98	-1747	-60	1477	351.8	12.1
		TOTAL										3186		-1260			365

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.60)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 2, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	34	59	110	160	203

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	9	0	0	0	0	109	34	28	5	32	5	168	4.1	0.7
2	52	245	100	100	170	0	0	0	370	59	185	45	18	4	302	5.4	1.3
3	72	439	100	100	295	0	0	0	495	59	274	120	-2	-1	397	7.8	3.4
4	90	581	100	100	300	111	0	0	611	110	424	246	-89	-51	495	44.8	26.0
5	110	593	100	100	300	451	0	0	951	110	873	518	-351	-208	594	137.7	81.7
6	130	568	100	100	300	500	120	0	1120	160	1168	663	-553	-314	705	284.6	161.5
7	150	538	100	100	300	500	220	0	1220	160	1360	731	-691	-371	771	307.9	165.5
8	178	482	100	100	300	500	280	0	1280	160	1475	710	-773	-372	813	320.3	154.2
9	240	456	100	100	300	500	399	0	1399	160	1703	776	-936	-427	884	353.2	161.0
10	332	133	100	100	300	500	580	0	1580	160	2051	273	-1184	-158	997	399.8	53.3
11	487	69	100	100	300	500	1000	31	2031	203	2933	202	-1819	-125	1176	806.9	55.5
12	704	34	100	100	300	500	1000	517	2517	203	4117	142	-2736	-94	1477	981.6	33.8
		TOTAL										4430		-2112			898

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.61)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 2, -0.2 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	21	35	60	111	161	204

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	56	0	0	0	0	156	35	49	8	37	6	168	0.8	0.1
2	52	245	100	100	116	0	0	0	316	60	151	37	23	6	302	1.2	0.3
3	72	439	100	100	225	0	0	0	425	60	229	101	4	2	397	2.4	1.1
4	90	581	100	100	300	23	0	0	523	111	314	182	-27	-16	495	11.0	6.4
5	110	593	100	100	300	173	0	0	673	111	514	305	-145	-86	594	31.0	18.4
6	130	568	100	100	300	290	0	0	790	111	669	380	-236	-134	705	33.3	18.9
7	150	538	100	100	300	360	0	0	860	111	763	410	-291	-156	771	34.9	18.7
8	178	482	100	100	300	400	0	0	900	111	816	393	-322	-155	813	34.1	16.4
9	240	456	100	100	300	485	0	0	986	111	929	424	-388	-177	884	40.0	18.2
10	332	133	100	100	300	500	114	0	1114	161	1169	156	-559	-74	997	80.9	10.8
11	487	69	100	100	300	500	359	0	1359	161	1643	113	-898	-62	1176	126.6	8.7
12	704	34	100	100	300	500	674	0	1674	161	2251	77	-1333	-46	1477	136.3	4.7
			TOTAL									2585		-893			123

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.62)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 2, -0.5 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	21	35	60	111	161	204

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	41	0	0	0	0	141	35	42	7	35	6	168	1.7	0.3
2	52	245	100	100	138	0	0	0	338	60	167	41	19	5	302	3.1	0.8
3	72	439	100	100	253	0	0	0	453	60	249	109	-1	-0	397	4.8	2.1
4	90	581	100	100	300	59	0	0	559	111	362	210	-55	-32	495	25.1	14.6
5	110	593	100	100	300	278	0	0	778	111	653	388	-227	-135	594	72.1	42.8
6	130	568	100	100	300	415	0	0	915	111	836	475	-334	-190	705	82.3	46.7
7	150	538	100	100	300	496	0	0	996	111	944	507	-398	-214	771	88.2	47.4
8	178	482	100	100	300	500	44	0	1044	161	1034	498	-462	-222	813	159.8	77.0
9	240	456	100	100	300	500	142	0	1142	161	1224	558	-597	-272	884	178.5	81.4
10	332	133	100	100	300	500	290	0	1290	161	1509	201	-802	-107	997	202.7	27.0
11	487	69	100	100	300	500	612	0	1612	161	2132	147	-1248	-86	1176	301.6	20.8
12	704	34	100	100	300	500	991	0	1991	161	2864	99	-1772	-61	1477	355.6	12.2
			TOTAL									3239		-1308			373

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.63)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 2, -1.0 PRICE ELASTICITY, URBAN EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	21	35	60	111	161	204

IG	IL	HH Nos	CONS/HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	168	100	15	0	0	0	0	115	35	32	5	32	5	168	3.4	0.6
2	52	245	100	100	174	0	0	0	374	60	192	47	13	3	302	6.2	1.5
3	72	439	100	100	300	1	0	0	501	111	285	125	-10	-4	397	40.7	17.9
4	90	581	100	100	300	118	0	0	618	111	440	256	-101	-59	495	48.2	28.0
5	110	593	100	100	300	453	0	0	953	111	887	526	-364	-216	594	140.7	83.5
6	130	568	100	100	300	500	122	0	1122	161	1185	673	-570	-323	705	288.5	163.7
7	150	538	100	100	300	500	223	0	1223	161	1380	742	-709	-381	771	312.7	168.1
8	178	482	100	100	300	500	283	0	1283	161	1496	720	-792	-382	813	325.1	156.6
9	240	456	100	100	300	500	402	0	1402	161	1726	787	-957	-436	884	358.4	163.3
10	332	133	100	100	300	500	583	0	1583	161	2076	277	-1207	-161	997	405.4	54.0
11	487	69	100	100	300	500	1000	33	2033	204	2962	204	-1847	-127	1176	814.0	56.0
12	704	34	100	100	300	500	1000	520	2520	204	4154	143	-2772	-95	1477	990.6	34.1
			TOTAL									4503		-2177			927

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF URBAN HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN URBAN HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER URBAN HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL URBAN HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.64)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 2, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	53	88	116	137

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	63	0	0	0	0	0	63	18	14	6	21	9	89	4.3	1.8
2	52	577	100	66	0	0	0	0	166	32	47	27	44	25	171	0.4	0.2
3	72	846	100	100	58	0	0	0	258	53	97	82	45	38	249	0.4	0.3
4	90	966	100	100	123	0	0	0	323	53	138	134	39	38	320	0.1	0.1
5	110	851	100	100	195	0	0	0	395	53	184	157	33	28	382	0.6	0.5
6	130	653	100	100	266	0	0	0	466	53	229	150	26	17	440	1.1	0.7
7	150	412	100	100	300	209	0	0	709	88	472	194	-83	-34	624	21.6	8.9
8	178	379	100	100	300	253	0	0	753	88	518	196	-105	-40	698	14.0	5.3
9	240	302	100	100	300	341	0	0	841	88	611	184	-150	-45	779	15.7	4.8
10	332	55	100	100	300	471	0	0	971	88	748	41	-216	-12	884	22.1	1.2
11	487	17	100	100	300	500	218	0	1218	116	1082	18	-414	-7	1082	57.4	1.0
12	704	11	100	100	300	500	535	0	1535	116	1524	17	-682	-7	1263	114.7	1.3
						TOTAL						1206		9			26

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.65)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 2, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	53	88	116	137

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	22	0	0	0	0	0	22	18	5	2	7	3	89	11.1	4.8
2	52	577	100	44	0	0	0	0	144	32	38	22	40	23	171	2.2	1.3
3	72	846	100	100	68	0	0	0	268	53	103	87	44	37	249	0.8	0.7
4	90	966	100	100	136	0	0	0	336	53	146	142	38	36	320	0.7	0.7
5	110	851	100	100	210	0	0	0	410	53	194	165	31	27	382	1.2	1.0
6	130	653	100	100	284	0	0	0	484	53	241	157	25	16	440	1.9	1.3
7	150	412	100	100	300	299	0	0	799	88	567	233	-128	-53	624	44.4	18.3
8	178	379	100	100	300	353	0	0	853	88	624	236	-156	-59	698	39.3	14.9
9	240	302	100	100	300	453	0	0	953	88	729	220	-207	-62	779	44.2	13.3
10	332	55	100	100	300	500	98	0	1098	116	915	50	-313	-17	884	90.3	5.0
11	487	17	100	100	300	500	415	0	1415	116	1356	23	-580	-10	1082	140.5	2.4
12	704	11	100	100	300	500	782	0	1782	116	1867	21	-890	-10	1263	218.9	2.4
.					TOTAL							1358		-68			66

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.66)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 1, TYPE 2, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	53	88	116	137

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	8	0	0	0	0	108	32	25	14	35	20	171	5.2	3.0
3	72	846	100	100	85	0	0	0	285	53	114	96	42	36	249	1.6	1.3
4	90	966	100	100	158	0	0	0	358	53	160	155	36	35	320	1.7	1.6
5	110	851	100	100	237	0	0	0	437	53	211	179	29	25	382	2.4	2.1
6	130	653	100	100	300	15	0	0	515	88	267	174	16	10	440	19.0	12.4
7	150	412	100	100	300	449	0	0	949	88	725	299	-205	-84	624	82.5	34.0
8	178	379	100	100	300	500	21	0	1021	116	808	306	-248	-94	698	136.2	51.6
9	240	302	100	100	300	500	141	0	1141	116	975	294	-349	-106	779	152.7	46.1
10	332	55	100	100	300	500	311	0	1311	116	1212	67	-493	-27	884	180.1	9.9
11	487	17	100	100	300	500	743	0	1743	116	1813	31	-857	-15	1082	278.8	4.7
12	704	11	100	100	300	500	1000	195	2195	137	2491	27	-1288	-14	1263	510.5	5.6
						TOTAL						1643		-214			183

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.67)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 2, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	57	108	158	201

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	63	0	0	0	0	0	63	18	14	6	21	9	89	4.3	1.8
2	52	577	100	66	0	0	0	0	166	32	47	27	44	25	171	0.4	0.2
3	72	846	100	100	61	0	0	0	261	57	102	86	41	35	249	0.8	0.7
4	90	966	100	100	127	0	0	0	327	57	147	142	32	31	320	0.5	0.5
5	110	851	100	100	199	0	0	0	399	57	196	167	23	19	382	1.2	1.0
6	130	653	100	100	271	0	0	0	471	57	245	160	13	8	440	2.1	1.4
7	150	412	100	100	300	221	0	0	721	108	552	227	-156	-64	624	36.3	14.9
8	178	379	100	100	300	266	0	0	766	108	610	231	-190	-72	698	25.4	9.6
9	240	302	100	100	300	356	0	0	856	108	727	219	-257	-78	779	28.8	8.7
10	332	55	100	100	300	488	0	0	988	108	898	49	-356	-20	884	38.9	2.1
11	487	17	100	100	300	500	241	0	1241	158	1370	23	-690	-12	1082	107.1	1.8
12	704	11	100	100	300	500	563	0	1563	158	1981	22	-1123	-12	1263	202.1	2.2
					TOTAL							1360		-129			45

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.68)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 2, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	57	108	158	201

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	22	0	0	0	0	0	22	18	5	2	7	3	89	11.1	4.8
2	52	577	100	44	0	0	0	0	144	32	38	22	40	23	171	2.2	1.3
3	72	846	100	100	76	0	0	0	276	57	112	95	39	33	249	1.8	1.5
4	90	966	100	100	146	0	0	0	346	57	160	154	30	29	320	1.8	1.7
5	110	851	100	100	222	0	0	0	422	57	212	180	20	17	382	2.7	2.3
6	130	653	100	100	298	0	0	0	498	57	264	172	9	6	440	3.9	2.6
7	150	412	100	100	300	329	0	0	829	108	692	285	-237	-98	624	76.6	31.6
8	178	379	100	100	300	387	0	0	887	108	767	291	-280	-106	698	70.6	26.8
9	240	302	100	100	300	491	0	0	991	108	902	272	-358	-108	779	79.2	23.9
10	332	55	100	100	300	500	141	0	1141	158	1181	65	-555	-31	884	173.2	9.5
11	487	17	100	100	300	500	472	0	1472	158	1808	31	-1001	-17	1082	262.8	4.5
12	704	11	100	100	300	500	854	0	1854	158	2532	28	-1516	-17	1263	398.2	4.4
						TOTAL						1597		-265			115

ABBREVIATIONS:
- IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)
- MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
- HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
- MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
- EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
- TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
- OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
- ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
- WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
- TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.69)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 2, TYPE 2, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	18	32	57	108	158	201

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	8	0	0	0	0	108	32	25	14	35	20	171	5.2	3.0
3	72	846	100	100	100	0	0	0	300	57	128	109	36	31	249	3.5	2.9
4	90	966	100	100	177	0	0	0	377	57	181	175	26	25	320	3.9	3.7
5	110	851	100	100	260	0	0	0	460	57	238	202	14	12	382	5.3	4.5
6	130	653	100	100	300	41	0	0	541	108	318	208	-22	-14	440	37.8	24.7
7	150	412	100	100	300	500	9	0	1009	158	930	383	-377	-155	624	259.4	106.9
8	178	379	100	100	300	500	88	0	1088	158	1080	409	-483	-183	698	262.8	99.6
9	240	302	100	100	300	500	216	0	1216	158	1323	399	-656	-198	779	294.5	88.9
10	332	55	100	100	300	500	396	0	1396	158	1664	92	-898	-49	884	345.0	19.0
11	487	17	100	100	300	500	856	0	1856	158	2536	43	-1518	-26	1082	521.5	8.9
12	704	11	100	100	300	500	1000	338	2338	201	3624	40	-2342	-26	1263	1001.7	11.0
.						TOTAL						2074		-564			384

ABBREVIATIONS:
- IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)
- MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
- HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
- MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
- EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
- TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
- OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
- ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
- WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
- TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.70)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 2, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	59	99	131	155

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	65	0	0	0	0	0	65	19	15	6	21	9	89	3.8	1.6
2	52	577	100	71	0	0	0	0	171	35	53	30	41	24	171	0.0	0.0
3	72	846	100	100	62	0	0	0	262	59	109	92	35	30	249	1.0	0.9
4	90	966	100	100	128	0	0	0	328	59	155	150	24	24	320	0.6	0.6
5	110	851	100	100	201	0	0	0	401	59	207	176	13	11	382	1.5	1.3
6	130	653	100	100	274	0	0	0	474	59	259	169	1	1	440	2.7	1.8
7	150	412	100	100	300	216	0	0	716	99	534	220	-141	-58	624	29.4	12.1
8	178	379	100	100	300	261	0	0	761	99	587	223	-170	-64	698	20.1	7.6
9	240	302	100	100	300	350	0	0	850	99	693	209	-227	-69	779	22.7	6.9
10	332	55	100	100	300	481	0	0	981	99	849	47	-311	-17	884	31.0	1.7
11	487	17	100	100	300	500	228	0	1228	131	1230	21	-556	-9	1082	74.7	1.3
12	704	11	100	100	300	500	547	0	1547	131	1731	19	-883	-10	1263	145.4	1.6
.						TOTAL						1362		-130			37

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.71)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 2, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	59	99	131	155

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	28	0	0	0	0	0	28	19	6	3	9	4	89	9.8	4.2
2	52	577	100	55	0	0	0	0	155	35	46	26	39	23	171	1.0	0.6
3	72	846	100	100	79	0	0	0	279	59	121	102	32	27	249	2.4	2.0
4	90	966	100	100	150	0	0	0	350	59	171	165	21	20	320	2.4	2.3
5	110	851	100	100	227	0	0	0	427	59	226	192	9	7	382	3.6	3.1
6	130	653	100	100	300	4	0	0	504	99	282	184	-6	-4	440	20.5	13.4
7	150	412	100	100	300	317	0	0	817	99	654	269	-206	-85	624	61.7	25.4
8	178	379	100	100	300	374	0	0	874	99	722	273	-242	-92	698	56.3	21.3
9	240	302	100	100	300	476	0	0	976	99	843	254	-307	-93	779	63.0	19.0
10	332	55	100	100	300	500	124	0	1124	131	1066	59	-450	-25	884	122.8	6.8
11	487	17	100	100	300	500	440	0	1440	131	1563	27	-773	-13	1082	183.2	3.1
12	704	11	100	100	300	500	813	0	1813	131	2149	24	-1155	-13	1263	281.5	3.1
					TOTAL							1578		-242			104

ABBREVIATIONS:

IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)

MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)

HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)

MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)

EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)

TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)

OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)

ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)

WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)

TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]

2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.72)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 3, TYPE 2, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	59	99	131	155

IG	IL	HH No*	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	129	35	35	20	36	21	171	2.7	1.6
3	72	846	100	100	107	0	0	0	307	59	141	119	28	24	249	4.6	3.9
4	90	966	100	100	186	0	0	0	386	59	196	190	15	15	320	5.3	5.1
5	110	851	100	100	270	0	0	0	470	59	256	218	2	2	382	7.0	6.0
6	130	653	100	100	300	53	0	0	553	99	340	222	-37	-24	440	36.1	23.6
7	150	412	100	100	300	485	0	0	985	99	853	352	-313	-129	624	115.4	47.6
8	178	379	100	100	300	500	61	0	1061	131	967	367	-385	-146	698	185.8	70.4
9	240	302	100	100	300	500	186	0	1186	131	1164	351	-513	-155	779	208.3	62.9
10	332	55	100	100	300	500	362	0	1362	131	1440	79	-693	-38	884	244.6	13.5
11	487	17	100	100	300	500	792	0	1792	131	2116	36	-1133	-19	1082	363.4	6.2
12	704	11	100	100	300	500	1000	257	2257	155	2921	32	-1683	-19	1263	651.9	7.2
.					TOTAL							1985		-470			258

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NO*: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000'*)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.73)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 2, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	63	119	173	219

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	65	0	0	0	0	0	65	19	15	6	21	9	89	3.8	1.6
2	52	577	100	71	0	0	0	0	171	35	53	30	41	24	171	0.0	0.0
3	72	846	100	100	65	0	0	0	265	63	114	96	31	27	249	1.7	1.4
4	90	966	100	100	132	0	0	0	332	63	165	159	17	17	320	1.2	1.2
5	110	851	100	100	205	0	0	0	405	63	220	187	2	2	382	2.4	2.0
6	130	653	100	100	278	0	0	0	478	63	275	180	-13	-8	440	3.9	2.6
7	150	412	100	100	300	226	0	0	726	119	614	253	-216	-89	624	44.9	18.5
8	178	379	100	100	300	272	0	0	772	119	680	258	-257	-97	698	32.5	12.3
9	240	302	100	100	300	362	0	0	862	119	809	244	-336	-101	779	36.5	11.0
10	332	55	100	100	300	495	0	0	995	119	998	55	-453	-25	884	48.8	2.7
11	487	17	100	100	300	500	247	0	1247	173	1518	26	-835	-14	1082	126.0	2.1
12	704	11	100	100	300	500	570	0	1570	173	2189	24	-1328	-15	1263	234.5	2.6
.					TOTAL							1518		-272			58

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.74)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 2, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	63	119	173	219

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	28	0	0	0	0	0	28	19	6	3	9	4	89	9.8	4.2
2	52	577	100	55	0	0	0	0	155	35	46	26	39	23	171	1.0	0.6
3	72	846	100	100	85	0	0	0	285	63	129	109	27	23	249	3.7	3.2
4	90	966	100	100	158	0	0	0	358	63	184	178	12	12	320	3.9	3.8
5	110	851	100	100	236	0	0	0	436	63	243	207	-4	-4	382	5.6	4.8
6	130	653	100	100	300	14	0	0	514	119	312	203	-30	-19	440	32.5	21.3
7	150	412	100	100	300	341	0	0	841	119	779	321	-317	-131	624	95.4	39.3
8	178	379	100	100	300	401	0	0	901	119	864	328	-370	-140	698	89.3	33.8
9	240	302	100	100	300	500	6	0	1006	173	1018	307	-466	-141	779	173.4	52.4
10	332	55	100	100	300	500	158	0	1158	173	1334	73	-699	-38	884	209.3	11.5
11	487	17	100	100	300	500	485	0	1485	173	2012	34	-1198	-20	1082	307.8	5.2
12	704	11	100	100	300	500	871	0	1871	173	2814	31	-1788	-20	1263	464.4	5.1
.					TOTAL							1821		-452			185

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.75)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 4, TYPE 2, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	19	35	63	119	173	219

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	129	35	35	20	36	21	171	2.7	1.6
3	72	846	100	100	119	0	0	0	319	63	155	131	20	17	249	7.3	6.1
4	90	966	100	100	202	0	0	0	402	63	218	210	3	3	320	8.5	8.2
5	110	851	100	100	289	0	0	0	489	63	283	241	-15	-13	382	11.1	9.5
6	130	653	100	100	300	75	0	0	575	119	399	260	-83	-54	440	59.4	38.8
7	150	412	100	100	300	500	34	0	1034	173	1076	443	-509	-210	624	313.2	129.0
8	178	379	100	100	300	500	116	0	1116	173	1246	472	-634	-240	698	319.3	121.0
9	240	302	100	100	300	500	246	0	1246	173	1516	458	-833	-252	779	356.7	107.7
10	332	55	100	100	300	500	430	0	1430	173	1898	104	-1114	-61	884	417.0	22.9
11	487	17	100	100	300	500	884	0	1884	173	2841	48	-1808	-31	1082	612.6	10.4
12	704	11	100	100	300	500	1000	372	2372	219	4059	45	-2758	-30	1263	1153.1	12.7
					TOTAL							2433		-851			478

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.76)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 2, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	35	60	95	125	147

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	67	0	0	0	0	0	67	20	16	7	21	9	89	3.4	1.5
2	52	577	100	71	0	0	0	0	171	35	54	31	40	23	171	0.0	0.0
3	72	846	100	100	63	0	0	0	263	60	111	94	33	28	249	1.2	1.0
4	90	966	100	100	129	0	0	0	329	60	159	153	22	21	320	0.8	0.7
5	110	851	100	100	202	0	0	0	402	60	211	180	9	8	382	1.7	1.5
6	130	653	100	100	275	0	0	0	475	60	264	172	-4	-2	440	3.0	2.0
7	150	412	100	100	300	214	0	0	714	95	526	217	-134	-55	624	26.6	11.0
8	178	379	100	100	300	258	0	0	758	95	576	218	-160	-61	698	17.7	6.7
9	240	302	100	100	300	347	0	0	847	95	678	205	-213	-64	779	20.1	6.1
10	332	55	100	100	300	478	0	0	978	95	827	45	-291	-16	884	27.8	1.5
11	487	17	100	100	300	500	225	0	1225	125	1190	20	-518	-9	1082	68.0	1.2
12	704	11	100	100	300	500	542	0	1542	125	1665	18	-819	-9	1363	85.2	0.9
.						TOTAL						1361		-128			34

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.77)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 2, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	35	60	95	125	147

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	33	0	0	0	0	0	33	20	8	3	10	4	89	8.6	3.7
2	52	577	100	55	0	0	0	0	155	35	47	27	38	22	171	1.0	0.6
3	72	846	100	100	81	0	0	0	281	60	124	105	30	25	249	2.7	2.3
4	90	966	100	100	152	0	0	0	352	60	175	169	18	17	320	2.7	2.7
5	110	851	100	100	230	0	0	0	430	60	232	197	4	4	382	4.1	3.5
6	130	653	100	100	300	6	0	0	506	95	289	189	-11	-7	440	19.5	12.7
7	150	412	100	100	300	311	0	0	811	95	637	262	-192	-79	624	55.3	22.8
8	178	379	100	100	300	367	0	0	867	95	700	265	-225	-85	698	50.0	18.9
9	240	302	100	100	300	468	0	0	968	95	816	246	-285	-86	779	55.9	16.9
10	332	55	100	100	300	500	115	0	1115	125	1025	56	-413	-23	884	109.9	6.0
11	487	17	100	100	300	500	431	0	1431	125	1499	25	-714	-12	1082	166.1	2.8
12	704	11	100	100	300	500	802	0	1802	125	2055	23	-1067	-12	1363	208.9	2.3
							TOTAL					1569		-232			95

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.78)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 5, TYPE 2, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	35	60	95	125	147

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	129	35	36	21	35	20	171	2.7	1.6
3	72	846	100	100	110	0	0	0	310	60	145	123	25	21	249	5.2	4.4
4	90	966	100	100	190	0	0	0	390	60	203	196	11	11	320	6.0	5.8
5	110	851	100	100	275	0	0	0	475	60	264	225	-4	-3	382	8.0	6.8
6	130	653	100	100	300	59	0	0	559	95	349	228	-43	-28	440	35.2	23.0
7	150	412	100	100	300	473	0	0	973	95	821	338	-288	-119	624	103.2	42.5
8	178	379	100	100	300	500	48	0	1048	125	924	350	-349	-132	698	166.5	63.1
9	240	302	100	100	300	500	171	0	1171	125	1109	335	-466	-141	779	186.5	56.3
10	332	55	100	100	300	500	345	0	1345	125	1370	75	-632	-35	884	219.3	12.1
11	487	17	100	100	300	500	774	0	1774	125	2013	34	-1040	-18	1082	329.3	5.6
12	704	11	100	100	300	500	1000	234	2234	147	2765	30	-1540	-17	1363	529.4	5.8
.						TOTAL						1955		-440			237

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.79)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 2, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	34	59	110	160	203

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	67	0	0	0	0	0	67	20	16	7	21	9	89	3.4	1.5
2	52	577	100	69	0	0	0	0	169	34	52	30	41	23	171	0.1	0.1
3	72	846	100	100	62	0	0	0	262	59	109	92	35	30	249	1.0	0.9
4	90	966	100	100	128	0	0	0	328	59	155	150	24	24	320	0.6	0.6
5	110	851	100	100	201	0	0	0	401	59	207	176	13	11	382	1.5	1.3
6	130	653	100	100	274	0	0	0	474	59	259	169	1	1	440	2.7	1.8
7	150	412	100	100	300	222	0	0	722	110	570	235	-174	-72	624	37.8	15.6
8	178	379	100	100	300	267	0	0	767	110	630	239	-209	-79	698	26.6	10.1
9	240	302	100	100	300	357	0	0	857	110	748	226	-278	-84	779	30.1	9.1
10	332	55	100	100	300	489	0	0	989	110	923	51	-380	-21	884	40.5	2.2
11	487	17	100	100	300	500	242	0	1242	160	1402	24	-721	-12	1082	109.7	1.9
12	704	11	100	100	300	500	564	0	1564	160	2020	22	-1162	-13	1363	137.8	1.5
.						TOTAL						1420		-184			46

ABBREVIATIONS:
IG: INCOME GROUP   IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.80)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 2, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	34	59	110	160	203

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	33	0	0	0	0	0	33	20	8	3	10	4	89	8.6	3.7
2	52	577	100	52	0	0	0	0	152	34	45	26	38	22	171	1.3	0.8
3	72	846	100	100	79	0	0	0	279	59	121	102	32	27	249	2.4	2.0
4	90	966	100	100	150	0	0	0	350	59	171	165	21	20	320	2.4	2.3
5	110	851	100	100	227	0	0	0	427	59	226	192	9	7	382	3.6	3.1
6	130	653	100	100	300	4	0	0	504	110	282	184	-6	-4	440	24.7	16.1
7	150	412	100	100	300	332	0	0	832	110	715	295	-259	-107	624	80.2	33.1
8	178	379	100	100	300	390	0	0	890	110	792	300	-304	-115	698	74.1	28.1
9	240	302	100	100	300	494	0	0	994	110	929	281	-384	-116	779	82.9	25.0
10	332	55	100	100	300	500	144	0	1144	160	1214	67	-586	-32	884	178.3	9.8
11	487	17	100	100	300	500	474	0	1474	160	1847	31	-1039	-18	1082	268.8	4.6
12	704	11	100	100	300	500	856	0	1856	160	2581	28	-1563	-17	1363	338.1	3.7
						TOTAL						1675		-328			132

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.81)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 6, TYPE 2, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	20	34	59	110	160	203

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	22	0	0	0	0	122	34	33	19	34	20	171	3.4	2.0
3	72	846	100	100	107	0	0	0	307	59	141	119	28	24	249	4.6	3.9
4	90	966	100	100	186	0	0	0	386	59	196	190	15	15	320	5.3	5.1
5	110	851	100	100	270	0	0	0	470	59	256	218	2	2	382	7.0	6.0
6	130	653	100	100	300	53	0	0	553	110	347	227	-44	-29	440	43.6	28.5
7	150	412	100	100	300	500	14	0	1014	160	964	397	-408	-168	624	267.5	110.2
8	178	379	100	100	300	500	94	0	1094	160	1118	424	-518	-196	698	271.6	102.9
9	240	302	100	100	300	500	222	0	1222	160	1363	412	-693	-209	779	303.8	91.8
10	332	55	100	100	300	500	403	0	1403	160	1711	94	-942	-52	884	355.9	19.6
11	487	17	100	100	300	500	860	0	1860	160	2588	44	-1568	-27	1082	533.6	9.1
12	704	11	100	100	300	500	1000	343	2343	203	3693	41	-2408	-26	1363	924.9	10.2
						TOTAL						2183		-648			400

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.82)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 2, -0.2 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	21	35	60	111	161	204

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	69	0	0	0	0	0	69	21	17	7	20	9	89	3.0	1.3
2	52	577	100	71	0	0	0	0	171	35	55	32	39	22	171	0.0	0.0
3	72	846	100	100	63	0	0	0	263	60	113	95	32	27	249	1.2	1.0
4	90	966	100	100	129	0	0	0	329	60	160	155	20	20	320	0.8	0.7
5	110	851	100	100	202	0	0	0	402	60	213	181	8	7	382	1.7	1.5
6	130	653	100	100	275	0	0	0	475	60	265	173	-5	-3	440	3.0	2.0
7	150	412	100	100	300	223	0	0	723	111	580	239	-184	-76	624	38.8	16.0
8	178	379	100	100	300	268	0	0	768	111	640	243	-219	-83	698	27.4	10.4
9	240	302	100	100	300	358	0	0	858	111	760	230	-290	-87	779	31.0	9.3
10	332	55	100	100	300	490	0	0	990	111	936	51	-393	-22	884	41.5	2.3
11	487	17	100	100	300	500	242	0	1242	161	1417	24	-736	-13	1082	110.7	1.9
12	704	11	100	100	300	500	565	0	1565	161	2041	22	-1183	-13	1363	139.7	1.5
							TOTAL					1452		-212			48

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.83)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 2, -0.5 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	21	35	60	111	161	204

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	38	0	0	0	0	0	38	21	10	4	11	5	89	7.6	3.2
2	52	577	100	55	0	0	0	0	155	35	48	28	37	21	171	1.0	0.6
3	72	846	100	100	81	0	0	0	281	60	126	106	29	24	249	2.7	2.3
4	90	966	100	100	152	0	0	0	352	60	177	171	16	16	320	2.7	2.7
5	110	851	100	100	230	0	0	0	430	60	233	198	3	3	382	4.1	3.5
6	130	653	100	100	300	6	0	0	506	111	291	190	-14	-9	440	25.9	16.9
7	150	412	100	100	300	333	0	0	833	111	727	299	-270	-111	624	81.9	33.7
8	178	379	100	100	300	391	0	0	891	111	804	305	-315	-120	698	75.6	28.7
9	240	302	100	100	300	495	0	0	995	111	943	285	-397	-120	779	84.6	25.6
10	332	55	100	100	300	500	146	0	1146	161	1231	68	-603	-33	884	181.3	10.0
11	487	17	100	100	300	500	475	0	1475	161	1867	32	-1058	-18	1082	271.9	4.6
12	704	11	100	100	300	500	858	0	1858	161	2607	29	-1588	-17	1363	342.4	3.8
							TOTAL					1713		-360			136

ABBREVIATIONS:
IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:
1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

TABLE (A5.84)

TOTAL ELECTRICITY EXPENDITURE, OVERCOST, & WELFARE LOSS PER INCOME GROUP
SCENARIO 7, TYPE 2, -1.0 PRICE ELASTICITY, RURAL EGYPT

BAND	1	2	3	4	5	6
UPPER LIMIT (KWH)	100	200	500	1000	2000	2000+
TARIFF (MILLS/KWH)	21	35	60	111	161	204

IG	IL	HH Nos	CONS /HH IN EACH BAND (KWH)						MC CONS	MAR TAR	EXP	TOT EXP	OC	TOTAL OC	ACT CONS	WELF LOSS	TOT LOSS
1	26	428	0	0	0	0	0	0	0	--	0	0	0	0	89	24.4	10.4
2	52	577	100	29	0	0	0	0	129	35	37	22	33	19	171	2.7	1.6
3	72	846	100	100	110	0	0	0	310	60	146	124	24	20	249	5.2	4.4
4	90	966	100	100	190	0	0	0	390	60	204	197	10	10	320	6.0	5.8
5	110	851	100	100	275	0	0	0	475	60	265	226	-5	-4	382	8.0	6.8
6	130	653	100	100	300	59	0	0	559	111	362	236	-55	-36	440	46.6	30.4
7	150	412	100	100	300	500	16	0	1016	161	980	404	-423	-174	624	271.2	111.7
8	178	379	100	100	300	500	96	0	1096	161	1135	430	-534	-202	698	275.3	104.4
9	240	302	100	100	300	500	225	0	1225	161	1384	418	-712	-215	779	308.5	93.2
10	332	55	100	100	300	500	406	0	1406	161	1734	95	-963	-53	884	361.1	19.9
11	487	17	100	100	300	500	862	0	1862	161	2615	44	-1593	-27	1082	539.6	9.2
12	704	11	100	100	300	500	1000	346	2346	204	3728	41	-2442	-27	1363	933.7	10.3
						TOTAL						2237		-690			408

ABBREVIATIONS:

IG: INCOME GROUP IL: INCOME LEVEL (L.E./MONTH)
MAR TAR: MARGINAL TARIFF PER INCOME GROUP (MILLS/KWH)
HH NOs: TOTAL NUMBER OF RURAL HOUSEHOLDS PER INCOME GROUP (000's)
MC CONS: CONSUMPTION BASED UPON MARGINAL COST (KWH/MONTH)
EXP: ANNUAL HOUSEHOLD EXPENDITURE ON ELECTRICITY PER INCOME GROUP (L.E.)
TOT EXP: TOTAL ANNUAL ELECTRICITY EXPENDITURE IN RURAL HOUSEHOLDS PER INCOME GROUP (L.E. MILLION)
OC: OVERCOST PER RURAL HOUSEHOLD IN EACH INCOME GROUP (L.E./YEAR)
ACT CONS: TOTAL ACTUAL ELECTRICITY CONSUMPTION PER HOUSEHOLD IN EACH GROUP (KWH/MONTH)
WELF LOSS: WELFARE LOSS PER URBAN HOUSEHOLD IN EACH GROUP (L.E./YEAR)
TOT LOSS : TOTAL WELFARE LOSS FOR ALL RURAL HOUSEHOLDS IN EACH INCOME GROUP (L.E. MILLION/YEAR)

SOURCES:

1) ACTUAL CONSUMPTION DATA FROM UPDATED HOUSEHOLD SURVEY ACQUIRED THROUGH CAPMAS [14]
2) DETAILS OF THE CALCULATIONS ARE GIVEN IN CHAPTER 5, SECTION 5

CHAPTER SIX

CONCLUSIONS

The demand for electricity in Egypt has been growing at exceedingly high rates since the mid Seventies. While the industrial sector was responsible for the majority of electricity consumption until the late Seventies, the share of the residential sector in total electricity consumption has surged massively since then. This upsurge in residential electricity consumption was due not only to high population growth rates and higher levels of income, but perhaps most important of all, due to massive subsidies on electricity prices in the residential sector. Subsidies which, as we argued in several parts of the thesis, were not justified given the true economic costs of electricity supply. Thus, without correct cost signals for consumers of electricity the end-result has been a wasteful and unnecessary use of electricity.

Electricity subsidies are part of a wider subsidy programme introduced over half a century ago but which has intensified since then. The main objective of this overall subsidy programme of the Egyptian government was to insulate the economy from inflation. Regarding electricity, a major objective was to provide poor and low-income segments of the population with affordable power. This has had two main consequences: First and foremost, the benefits of the subsidy programme, in effect, were not limited to the target group of consumers but were passed on to the richer consumers as well. Second, as a result of the subsidizing of electricity prices, consumption increased substantially. Due to the fact that hydropower has reached its maximum capacity in Egypt, this has meant that electricity generation has had to rely increasingly on fossil fuel. Since Egypt is a net oil exporter, increased reliance on fossil fuel for electricity generation has meant a reduction in the volume of oil available for export. Thus, not only has the electricity subsidy imposed a burden on the government budget, it has also led to a reduction in export revenues in the form of already-scarce foreign exchange revenues.

There is thus a pressing need to abolish all forms of subsidies in the economy - including those in electricity - due to the distortionary impacts they have on the economy and, simultaneously, to introduce alternative means to redistribute income. Regarding the latter, we mentioned a few measures in the field of electricity, most notably the coupon system, whereby the government would issue special coupons for certain targeted groups of the population which could be used as payment for electricity bills or for staple foods. However, this scheme is not only expensive to execute but there are certain administrative problems in its implementation as well.

As regards electricity tariffs, we argued that there are certain basic principles that need to be followed in their formulation, one of which is that it has to reflect the true costs of supply so that consumers would get the correct price signals. In brief, the tariff has to satisfy the criterion of economic efficiency. However, for the satisfaction of the other necessary criterion, namely equity, the tariff would also have to ensure that less fortunate consumers get enough for their needs. Therefore, the tariff structure would have to be designed to both reflect the marginal costs of electricity supply as well as provide life-line rates for the poor consumers. One important requirement is that rich consumers need to subsidize the consumption of poorer ones so that the tariff structure will realize revenue over costs. In fact, the realization of a surplus is crucial for the financial viability and autonomy of the electricity authority.

With regard to the context of increasing electricity prices in order to achieve efficiency pricing, we proposed several tariff structures based on certain initial conditions. We then calculated the expenditure and revenues associated with each tariff structure using an updated household survey, which enabled calculations at different income levels and in urban households as well as rural households. Most important, we calculated the welfare cost incurred by each tariff structure. That is, we measured the net cost society incurred by deviating from pricing at marginal cost. The main objective of this exercise was to recommend the tariff structure which yields the least welfare cost while generating revenues simultaneously. The issue of equity was introduced in the analysis by acknowledging the fact that some consumers at the lower end of the tariff structure would have to forego some of their consumption (if not all) were prices to be based on marginal cost. We therefore suggested that the policy-maker (or indeed further research) should consider devising some criteria to assess the loss in consumption by consumers at the lower-end vis-a-vis the gain by others at the top-end.

In brief, this thesis presented a methodology, using which, policy-makers in Egypt could assess and evaluate the feasibility of applying any given tariff structure, in terms of its impact on consumption, revenue, and expenditure; and above all, in terms of the associated welfare loss as valued by society.

REFERENCES

[1] Abdel Khalek, G., Some Preliminary Estimates of Income and Price Elasticities of Energy Consumption in Egypt, DRTPC/Cairo University, 1984.

[2] Abdullah, H., "The Energy Situation in the Arab Republic of Egypt", Journal of Energy and Development, Vol 7, No 2, Spring 1982, pp 213-224.

[3] ————————, "Alternative Scenarios for Pricing Petroleum Products in Egypt", Oil and Arab Cooperation, OAPEC, (in Arabic), Vol 10, No 1, 1984, pp 103-151.

[4] Abou Neima, F.A., Marginal Generation and Transmission Cost for Tarification, Unpublished MSc Thesis, Ain Shams University, Cairo, 1986.

[5] Anderson, R., & Bohman, M., "Short-and Long-Run Marginal Cost Pricing on their Alleged Equivelance", Energy Economics, October 1985, pp 283-286.

[6] Beardshaw, J., Economics: A Student's Guide, Second Edition, Pitman, 1989.

[7] Berrie, T., & Leslie, I., "Energy Policy in Developing Countries", Energy Policy, June 1978, pp 124-128.

[8] Bohi, D.R., Analyzing Demand Behaviour: A Study of Energy Elasticities, The Johns Hopkins University Press for Resources of the Future, Baltimore, MD, 1981.

[9] Boiteux, M., "Peak Load Pricing", in Nelson, J., (eds), Marginal Cost Pricing, Prentice Hall, 1964, pp 59-89.

[10] Brookes, L.G., "More on the Output Elasticity of Energy Consumption", Journal of Industrial Economics, Vol 21, November 1972, pp 89-92.

[11] ——————, "Energy/GDP Relationships; The Elastic Snap", Energy Policy, Vol 5, No 2, June 1977.

[12] Central Agency for Public Mobilization and Statistics (CAPMAS), Statistical Yearbook, Cairo, Several Issues, 1980-1989.

[13] ——————, Infrastructure for the Electricity Sector in Egypt, Special Report, (in Arabic), 1988.

[14] ——————, Household Expenditure Survey 1981/82, Unpublished Survey Conducted by CAPMAS, Followed by a More Recent Update Acquired Through Personal Communication.

[15] Central Bank of Egypt (CBE), Economic Journal, Cairo, Several Issues, 1983-1989.

[16] ——————, Annual Report and Quarterly Bulletin, Several Issues, 1985-1990.

[17] Ciochetti, C.J., Allen, W.J., & Smolensky, P., The Marginal Cost Pricing of Electricity, Cambridge, Mass, Balinger Publishing Company, 1977.

[18] Coase, R.H., "The Marginal Cost Controversy", Economica, Vol 13, August 1946, pp 169-182.

[19] ——————, "The Theory of Public Utility Pricing and Its Applications", The Bell Journal of Economics and Management Science, Vol 1, Spring 1970.

[20] Comanor, W.S., & Leibestein, H., "Allocated Efficiency, X-Efficiency and the Measurement of Welfare Losses", Economica, Vol 36, 1969, pp 304-309.

[21] Deaton, A., & Muellbauer, J., Economics and Consumer Behaviour, Cambridge University Press, 1986.

[22] Della Valle, A., "Short-Run Versus Long-Run Marginal Cost Pricing", Energy Economics, October 1988, pp 283-286.

[23] Dunkerley, J., "Energy Use Trends in Industrial Countries Implications for Conservation", Energy Policy, Vol 8, 1-4, 1980, pp 105-115.

[24] ——————, "Estimation of Energy Demand; The Developing countries", Energy Journal, Vol 3, No 2, April 1982.

[25] Egyptian Electricity Authority (EEA), Annual Report of Electricity Statistics, Cairo, Various Years, 1980-1989.

[26] ——————, Statistical and Commercial Indicators for Electricity and Gas Sales in 1979, (in Arabic), 1980.

[27] ——————, Economic Study of the Electricity Tariff Structure, (in Arabic), 1973.

[28] ——————, "Several Internal Memoranda on Electricity Tariffs", Department of Electricity Pricing, (in Arabic), 1982-1988.

[29] Egyptian General Petroleum Corporation (EGPC), Annual Report, Several Issues, (in Arabic), 1980-1986.

[30] Elhamamsy, A.K., The Demand for Electricity with Special Reference to Egypt, (in Arabic), The Egyptian Publishing Company, 1972.

[31] Elkassabgi, M.H., "Energy Consumption in Egypt", El Petrol, (in Arabic), Vol 17, 3-4, 1980.

[32] Ezz Eldin, R., "Electricity Pricing and the Energy Crisis in Egypt", Alahram Aliktisadi, (in Arabic), Issue: September 25, 1989, pp 64-68.

[33] Farid, F., "Electricity Consumption in Residential and Commercial Sectors and their Rationalization by Tarification", Workshop on electricity tariffs, DRTPC, Cairo University, 1983.

[34] Foster, C.D., & Neuberger, H.L., "The Ambiguity of the Consumer's Surplus Measure of Welfare Change", Oxford Economic Papers, Vol 26, pp 66-77, 1974.

[35] Galland, J.B., Lescoeur, B., & Varoquaux, W., "Principles of Electricity Pricing in France", Electricité de France, September 1984.

[36] Goode, Richard, Government Finance in Developing Countries, The Brookings Institution, 1984.

[37] Green, J., Consumer Theory, Revised Edition, McMillan, 1976.

[38] Heady, C., Public Sector Pricing in a Fiscal Context, Public Economics Working Paper 179, The World Bank, Washington D.C., April 1989.

[39] Hotelling, H., "The General Welfare in Relation to Problems of Taxation and of Railway and Utility Rates", Econometrica, Vol 6, 1938, pp 242-269.

[40] Houthakker, H.S., "Electricity Tariffs in Theory and Practice", Economic Journal, Vol 61, 1951, pp 1-25.

[41] Hume, I., "Energy Efficiency in Developing Countries", Policy, Planning and Research Working Paper, WPS 106, The World Bank, Washington D.C., January 1989.

[42] Ikram, K., Egypt: Economic Management in a Period of Transition, The Johns Hopkins University Press, Baltimore, MD, 1980.

[43] Kay, J.A., "Recent Contributions to the Theory of Marginal Cost Pricing, Some Comments", Economic Journal, 1971, pp 336-371.

[44] Kumar, M.S., "Socio-Economic Goals in Energy Pricing Policy: A Framework for Analysis", in Siddayao, C.M., (eds), Criteria for Energy Pricing Policy, Graham & Trotman, 1984, pp 35-61.

[45] Lipsey, R.G., & Lancaster, K., "The General Theory of the Second Best", Review of Economic Studies, Vol 24, No 63, 1965, pp 11-32.

[46] Markandya, A., Pemberton, M., & Sarhan, A., "Residential Electricity Pricing in Developing Countries", Journal of Egyptian Computer Society, Vol 12, No 2, 1989, pp 73-96.

[47] Markandya, A., & Pemberton, M., "Non-Linear Prices and Energy Demand", Energy Economics, January 1990, pp 27-34.

[48] Markandya, A., "Environmental Costs and Power Systems Planning", Utilities Policy, October 1990, pp 13-27.

[49] Messiha, S.A., "Egypt Subsidy Policy - Case Study: The Energy Sector", Unpublished Ph.D Thesis, Cairo University, Egypt, 1985.

[50] Munasinghe, M., The Economics of Power System Reliability and Planning, The Johns Hopkins University press, Baltimore, MD, 1979.

[51] ——————, "An Integrated Framework for Energy Pricing in Developing Countries", Energy Journal, Vol 1, No 3, 1980, pp 1-30.

[52] ——————, "Integrated National Energy Planning in Developing Countries", Natural Resources Forum, Vol 4, 1980, pp 359-373.

[53] ————————, "Principles of Modern Electricity Pricing", Proc. IEEE, Vol 69, 1981, pp 332-348.

[54] ————————, "Energy Pricing Policy: Framework and Experience in Developing Countries", in Siddayao, C.M., (eds), Criteria for Energy Pricing Policy, Graham & Trotman, 1984, pp 1-33.

[55] Munasinghe, M., & Rungta, S., Costing and Pricing Electricity in Developing Countries, Asian Development Bank, 1984.

[56] Munasinghe, M., & Warford, J., Electricity Pricing, The Johns Hopkins University Press, Baltimore, MD, 1982.

[57] National Bank of Egypt (NBE), Economic Bulletin, Cairo, Several Issues, 1981-1990.

[58] National Economic Research Associates, How to Quantify Marginal Cost, Topic 4, Washington D.C., March 1984.

[59] Newbery, D., "Efficiency and Equity Criteria in Energy Pricing with Practical Applications to Developing Countries in Asia", in Siddayao, C.M., (eds), Criteria for Energy Pricing Policy, Graham & Trotman, 1984, pp 65-88.

[60] Parikh, J., Energy and Development, Energy, Water and Telecommunications Department, The World Bank, Washington D.C., 1978.

[61] Patinkin, D., "Demand Curves and Consumer's Surplus", in Christ, C., et al (eds), Measurement in Economics: Studies in Mathematical Economics, Stanford, 1963.

[62] Pearce-Whitman-PEIDA Consortium, Petroleum Products Pricing Study, Second Interim Report, Cairo, Egyptian General Petroleum Corporation (EGPC), April 1981.

[63] Pearce, D., & Edwards, R., "Energy Policy in a Price-Regulated Developing Economy", Review of Economic Studies, Vol 11, No 1, 1985, pp 3-26.

[64] Pindyck, R.S., & Rubinfeld, D.L., Econometric Models and Economic Forecasts, McGraw-Hill, 1981.

[65] Pindyck, R.S., "Energy Demand in the Developing Countries", Chapter 7, in The Structure of World Energy Demand, MIT Press, Cambridge, Mass, 1979.

[66] Public Sector Organisation for Electricity Distribution, Annual Report, Cairo, Several Issues, 1984-1990.

[67] Pumpton, A., "The Basis of Electricity Tariffs in England and Wales", Electrical Power Engineer, U.K., March/April 1983.

[68] ——————, "Calculating the Marginal Costs of Supplying Electricity to Consumers", Electrical Power Engineer, U.K., September/October 1983.

[69] ——————, "From Costs to Tariffs", The Electricity Council, U.K., 1984.

[70] Ruggles, N., "Recent Developments in the Theory of Marginal Cost Pricing", Review of Economic Studies, Vol 17, pp 107-126, 1949.

[71] ——————, "The Welfare Basis of the Marginal Cost Pricing Principle", Review of Economic Studies, Vol 17, 1949.

[72] Sakr, A.S., Macro Implications of Food Subsidies in Egypt, Institute of National Planning, Cairo, Memo No 1302, December 1981.

[73] Sanderson, M., & Porter R., Egypt Power Sub-Sector Survey, DRTPC/Cairo University, November 1978.

[74] Sarhan, A., The Demand for Oil Products in Egypt, Unpublished MSc Thesis, University of Surrey, U.K., 1984.

[75] Spence, A.M., "Non-Linear Prices and Welfare", Journal of Public Economics, Vol 71, 1976, pp 585-610.

[76] Sibley, D.S., & Brown, S.J., The Theory of Public Utility Pricing, Cambridge University Press, 1986.

[77] Stiglitz, J.E., Economic of the Public Sector, Norton & Co, 1988.

[78] Tailor, L., "The Demand of Energy: A Survey of Price and Income Elasticities", in Nordhaus (eds), International Studies of the Demand for Energy, North Holland, 1977.

[79] Taylor, L., Food Subsidies in Egypt, MIT, Cambridge, Mass, 1979.

[80] Turvey, R., Optimal Pricing and Investment in Electricity Supply, George Allen & Unwin, 1968.

[81] Turvey, R., & Anderson, D., Electricity Economics, The Johns Hopkins University Press, Baltimore, MD, 1977.

[82] United Nations, Yearbook of Energy Statistics, Several Issues, 1978-1988.

[83] U.S. Department of Energy, Joint Egypt/U.S. Report on Egypt/U.S. Cooperative Energy Assessment, Washington, 1979.

[84] USAID, Food and Energy Subsidies in Egypt, Cairo, 1982.

[85] Waud, R.N., Economics, Harper & Row, 1989.

[86] Webb, M., "Policy on Energy Pricing", Energy policy, 1978, pp 53-65.

[87] Weitzman, M.L., Thoughts on the Energy Problem in Egypt, DRTPC/Cairo University, Cairo, 1981.

[88] Weitzman, M.L., & Kirtley, J.L., A Rational Tariff Policy for Egyptian Electric Power, MIT/Cairo University, Cairo, 1982.

[89] World Bank, Egypt Investment Review: Power Sub-sector Issues, Washington D.C., February 1984.

[90] ————, Egypt Power Generation Investment Review, Washington D.C., 1985.

[91] ————, World Development Report, Several Issues, Washington D.C., , 1979-1989.

[92] ————, Domestic Energy Pricing Policies, Energy Series Paper No 13, Washington D.C., April 1989.